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ELECTRICAL WORLD AND ENGINEER.

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THE POINT OF VIEW.

This is the season of the year when hundreds of young men, receiving the coveted diploma for which they have worked so long and hard, step out into the world as graduated electrical engineers and mechanical engineers; and are thus set apart and sealed to the professions toward which all their studies have been directed. It is a moment of anxiety as well as of congratulation for them and their relatives, but after all it is something that they cease to be merely part of the assimilative and destructive forces of the world and become portion of the influences and agencies that are to add to its stores and resources. Upon them in the next twenty-five years rests the virtual responsibility also for whatever advances American engineering is to make. Under these circumstances, it is not a little important that their training should have been broad, their culture deep, equal to and justifying alike their courage and their ambitions. How far this may be, no one can yet tell; but we do know how earnest and devoted has been the discharge of the professional functions under the exercise of which these young men have been shaped; and we can, therefore, but hope that the outlook is sunny for these latest exemplars in the noblest of professions.

At the commencement of Stevens last week, Mr. Walter C. Kerr, in a felicitous address to the graduating class, as noted elsewhere in these pages, took occasion to dwell upon the importance of the "point of view" for these young engineers. His sententious wisdom and shrewd epitomizing of an engineer's experience can but be heartily commended to every beginner. "To thine own self be true" is its keynote, and this is peculiarly applicable where the powers and instrumentalities to be dealt with are so tremendous there might easily be a temptation to think that the mechanism was all and everything and the man went for naught. Mr. Kerr, moreover, wants his engineer to be an "all around" engineer. That is sound advice and philosophy, and it may fitly be carried further with the suggestion that the best object of all higher educational training is to create the "all around," manly man. It is for him that the world and society are looking, whatever be his differentiation as engineer, lawyer or physician.

As these young engineers emerge from the scholastic cloisters, one of the first inquiries is naturally as to the extent of the opportunities awaiting them. The current year may not perhaps be as insatiable in its demands for new blood as were the recent periods of gigantic activity, but there can be no doubt as to the work that awaits every one of them in the physical conquest of this continent or in the extension of American enterprise beyond the seas. In some ways the great consolidations may have restricted possibilities for the younger men, but that is very much open to doubt; and if it is actually so, it will prove but a temporary phase, for the next movement would be centrifugal and toward heterogeneity. Besides, there are many signs of newer days in electricity and mechanics. With radium on one side and the turbine and the gas engine on the other, no one knows yet in any degree what even these factors are cutting out in new work. As to cutting out also the Panama Canal is ahead, and it is not to be forgotten that the opening of the Suez Canal led to the swift, three-fold reconstruction of the mercantile fleets of the world, not to mention the navies. Hence, as we welcome the newly made engineers, we think it is quite safe to bid them let their "point of view" as to the future be a bright and cheerful one and then to

bend all their energies toward making this world better and more habitable than they found it. If they do just this all the other things will be added unto them.

Foucault Pendulum Systems.

The article by Mr. Ernest K. Adams on page 1120 of this issue describes a variety of Foucault pendulum suspension that might be tried for maintaining the swings of the pendulum indefinitely. So far as we are aware no apparatus more perfect than the original Pantheon pendulum has ever been exhibited on a large scale. That classical experiment, although entirely satisfactory as a demonstration, was necessarily very crude, because no means were provided for maintaining the swing, and the period of time during which the swing could be self-sustained within the required limits was necessarily limited. Nowadays it should be possible to overcome this difficulty without great expense, and a self-supporting free pendulum would be a very pretty thing, worth going far to see. The suggestions for improvement offered by Mr. Adams in the present and in a previous article should, when experimentally sifted, result in an apparatus possessing all of the requirements for permanent public exhibition; and as an object lesson in the fundamental conceptions of motion, a view of such an apparatus would be highly instructive to the public—not only the untutored portion, but even those who have by rote learned the laws of planetary motion.

A. I. E. E. Transactions.

The latest bound issue of the *Transactions* of the American Institute of Electrical Engineers is a slender volume which promises to be lost sight of on a shelf when sandwiched between its portly brothers. Another singularity about the volume is that while the title page describes the *Transactions* as covering the period from July 1 to December 31, 1902, the earliest date of transaction recorded is September 26, 1902. This miniature volume also puts an end to the further identity between the volume number and the age of the Institute. If the only reason for this odd volume is that the work of one administration should be separated from that of another, it would appear preferable to carry over matter corresponding to the beginning of an administration and include with it that of the remainder of the administration; or in case the extent of matter calls for two volumes, to divide it nearly equally to form two sections issued as "Parts" and carrying the same volume number. In any event, it does not seem desirable that the *Transactions* should continue to be issued in the form of a portly tome covering part of a year and a tiny complement covering the remainder. The prestige of the Institute rests very largely on its *Transactions,* and the form of these should not by their oddity give rise to adverse comment; and viewing the matter from the financial side, the cost of binding and distributing 3,000 or more copies of this extra volume probably formed no small draft on the slender resources of the Institute.

The Humming Telephone.

Accounts of the recent Conversazione of the Royal Society seem to show that the exhibits possessed more than usual interest. Every year the Royal Society holds a conversazione resembling somewhat the opening of the National Gallery of Art, in that the scientific exhibit of the year is made for the inspection of all beholders. The very successful A. I. E. E. Conversazione of 1901 showed that a similar custom could easily take root in New York, and we hope that the annual Institute dinner may occasionally in the future give way to a function of this kind. Among the exhibits at London was a curious application of the humming telephone. It is well known that if a telephone is placed in the circuit of the ordinary microphone transmitter, and held closely facing the same, the two will set up conversation in the form of a particular hum or musical note, the telephone diaphragm stimulating the transmitter to this note, and the transmitter reacting on the telephone. The apparatus referred to is described as consisting of a vibratory steel bar carrying a microphone. Vibrations started in the rod, generate currents of the same frequency in the microphone circuit. These currents are caused to act upon an electromagnet, which in turn stimulates the rod to yet more vigorous vibration. Induced alternating currents are tapped from the apparatus, considered as a high-frequency generator, for inductance measurements, or tests, in which only a relatively feeble unit-frequency current is desired.

The Architecture of Central Stations.

As a rule central stations are designed strictly in accordance with the Socratic canon of beauty, and judged by the ideals of date later than B. C. they are generally masterpieces of ugliness. With a few exceptions they follow the graceful design of a shoe box surmounted by several lengths of stove pipe rampant. A paper has recently come into our hands read by Mr. C. S. Peach before the Royal Institute of British Architects, which throws a new light on the possibility of combining sound design with some degree of architectural grace. It is rich in illustrations, derived mainly from Continental practice, of power stations great and small, marked by an attention to artistic effect quite unknown in this country. We should not, of course, expect too much of a building designed for brutally utilitarian purposes, particularly in these days of twenty-story steel boxes, when he is accounted the best architect who can most scamp his design so as to secure the minimum cost per cubic foot of volume and square foot of floor space. And we realize, too, that there should be some degree of appropriateness to the desired ends—that Notre Dame with its towers converted into smokestacks would lack a certain unity of conception. But joking aside, Mr. Peach's admirable paper shows very plainly that it is possible to build great power stations on thoroughly sound engineering principles without sacrificing architectural dignity and beauty. It is a lesson worth studying for its own sake, however small be one's reasonable hopes that it may be generally taken to heart.

To begin with, one may divide power stations into three classes—steam-driven central stations, hydraulic stations and auxiliary or sub-stations in which steam power is either absent or quite inconsequential. The first class is obviously by far the most difficult to treat architecturally on account of the necessity of chimneys, which may be short or tall according as artificial or natural draft is used, but still are chimneys with their purpose fully in evidence. Add to this necessity the considerable space required for boiler and engine rooms, coal storage and other purposes and the difficulties of the situation are self-evident. Yet in spite of all this, Mr. Peach shows that it is possible to unite the severe requirements in buildings that are at once dignified and picturesque. Especially commendable are the power stations of the municipalities of Munich and of Vienna. The latter, with its four huge stacks and great size, was particularly difficult of treatment, yet the final result is most admirable. The Munich station, much smaller, is equally good and the chimney is of particular interest as an innovation upon the usual designs. And the most striking thing about these and some other fine Continental stations is that the excellent architectural result is obtained without any material increase of cost—merely by knowing how to obtain good effects by simple and inexpensive means. In this connection the author very shrewdly points out that a little additional expenditure on the building to the benefit of the sur-

rounding property often brings large returns in good will and freedom from opposition and litigation. It is well to bear in mind that the rights of neighbors are being more and more upheld by the laws as time goes on, laying more and more emphasis on the doctrine that in a complexly organized community there are no absolute rights in property, but only predominant equities. It is this feature of the case that gives so great a value to public good will in enterprises of a permanent character.

Water power stations offer an entirely different set of conditions. Situated often in isolated situations and on sites closely defined by the hydraulic requirements, there is less need for an opportunity for architectural display. Yet now and then when a water power is developed in a city or when the situation is favorable elsewhere, capital effects can be and ought to be achieved. A beautiful example of the possibilities of hydraulic stations is cited by Mr. Peach in the station at Tivoli on the Tiber, which supplies the city of Rome. Here the aqueduct is built of masonry after the ancient Roman model and passes with hardly an architectural break into a stone power house clinging to the cliff above the river. More frequently, however, the necessity, real or supposed, of building very long and narrow stations makes anything by the crudest treatment quite impossible. The easiest case for the architect in electric power stations is found in the sub-stations now so frequently installed in connection with transmission plants and great central stations. These, generally speaking, are inside city limits, but they are not hampered by tall chimneys, and the apparatus brings no extraordinary requirements for space. The main difficulties are met with in securing adequate foundations so that no vibration shall be transmitted to neighboring buildings, and in planning the building so that the noise of the moving part of the machinery, if any, shall be suitably deadened. These are, so to speak, internal requirements on which engineer and architect must join forces; the exterior requirements give the latter for once a free hand. How effectively this opportunity may be grasped is admirably shown in Mr. Peach's own design for the great Mayfair motor-generator station of the Westminster Electric Supply Corporation, where a partially sunken station with graceful entrance porches is crowned by an Italian garden. Even without so radical a departure from ordinary methods there is no reason why a sub-station should not be built with an appropriate and decorative exterior. Mr. Peach has assuredly done a public service in showing how the material accompaniments of a great modern industry may be made harmonious and even artistic. We hope his lesson will not be forgotten in future construction.

THE STRUCTURE OF THE ATOM.

The present trend of scientific speculation and theoretical investigation is toward the interior of an atom of matter, or to examine into the nature of its works. Until the last few decades, chemical and physical theories of matter stopped at the atom. Every substance was supposed to be formed of molecules, and each molecule was an orderly arranged group of a definite number of atoms. Atoms might be spherical masses like very minute shot. All atoms of the same element were identically alike, and atoms of different elements were characteristically and eternally different. Chemistry desired no more than this working hypothesis. Physics needed no more. The kinetic theory of gases was thereby satisfied. But the progress of natural philosophy in general, and the development of spectrum analysis in particular, upset the crude simplicity of the atom, and demonstrated that each atom was probably at least as complicated inside as a solar system. The advantage gained by this intra-atomic complexity was that it enabled all kinds of atoms to be ideally constructed out of one and the same fundamental stuff, for which mother material the name "protyle" has been used. Different dynamic systems of moving particles of protyle thus formed the different kinds of the atoms of chemistry. Different aggregations of atoms formed molecules, and aggregations of molecules, or groups of molecules, formed the matter that our senses reveal to us. The advance in theory thus made promoted the atom from the minimum thinkable mass to a relatively large mass, although of absolutely very minute dimensions. It made the minimum thinkable quantity of mass the particle of protyle. The question then arose as to whether these ultimate particles of protyle were to be regarded as point-spheres, like shot, the shot in different atoms being all alike, but differing in number, grouping or activity. One form of the most recent electron theory regards these particles of protyle as point-charges of electricity. On this view different groupings of electric charges make up the different atoms, and so on. Consequently, on this theory, all matter is ultimately electricity, and electricity may be a special localized disturbance of the all-pervading ether; so that all matter is ultimately energized ether.

As bearing on this hypothesis, a very interesting paper "On the Structure of the Atom," by Prof. J. J. Thomson, appears in the *Philosophical Magazine* for March last. The article contains an analysis of the actions that would occur in an atom consisting of a number of electric point-charges subjected to certain assumed forces. The forces involved are three, namely: a centripetal electric force, toward the center of the atom, varying directly as the distance therefrom; secondly, a repulsion, due to the action of similar electric point-charges in the neighborhood; and, thirdly, centrifugal forces of inertia, due to planetary rotation of the charges about the center. This represents a sort of Newtonian planetary system inside the atom, except that the attraction toward the central sun increases as the planet is farther away, and that the planets push each other apart instead of mutually attracting. The writer tries to determine mathematically from these premises what groupings and velocities of the electrons, or corpuscle point-charges, would form stable atomic systems. The general problem in three dimensions has been too hard even for the well-known mathematical powers of the writer—but a number of solutions are given for two-dimensional distributions, in which the corpuscles are arranged in concentric rings, the rings moving around in the direction of their length, or tangentially to themselves.

It is shown in a masterly way that rings of three, four, five or six corpuscles are stable, at certain planetary velocities. Above six corpuscles, the rings require interior planets to effect stability. In the case of twenty-five or more corpuscles, three concentric rings would be required. With thirty-five or more, there would have to be four concentric rings, one within the other, and with fifty-five or more corpuscles, five concentric rings would be needed. The natural periods of vibration of such atomic systems would be both rotational and perturbational. The rotational period would be the period of a planetary "year," divided by the number of corpuscles in the ring belt. The perturbational periods would depend upon the proximity between neighboring corpuscles. It is shown that if all the possible stable arrangements are produced, the atomic systems may become periodic in their properties, suggesting the periodic series of the chemical elements as discovered by Mendelief. A number of other interesting chemical or electrochemical properties are indicated. While the theory of the article is necessarily tentative, yet it foreshadows the possibility of great progress being effected at no very distant date in theoretical and physical chemistry. It is quite conceivable that some day the student of chemistry will be able to compute mathematically all the possible chemical reactions of substances, without having to carry out the actual process in the laboratory. Howbeit, that end is not yet.

Honors at Stevens to Electrical Engineering.

The Stevens Institute of Technology, Hoboken, N. J., has contributed a large number of useful and influential men to all departments of engineering, and to-day has many worthy representatives in the field of mechanics and electricity. This year in the person of Mr. J. W. Lieb she has seen one of her graduates elected president of the American Institute of Electrical Engineers, a body on whose council she has already had recognition. And now a further bond of relationship is to be found in the fact that last week at the commencement exercises, Mr. Edward Weston was made by Stevens a Doctor of Science, this being the first time in its history that the Institute has conferred that degree. The relation between Mr. Weston and the graduates of Stevens has always been close and intimate, and ever since this distinguished engineer and inventor began his career at Newark, near by, the shops and plants under his management or name have given abundant occupation and opportunity to Stevens men. Not long ago Mr. Weston, an Englishman by birth, was made a Doctor of Laws by McGill University, but it is even more fitting that the specific technical recognition should come from New Jersey and the country of his adoption.

In presenting Mr. Weston for the degree of Doctor of Science on June 16, President Humphreys said: "In addition to conferring degrees for work done in course, Stevens Institute, in common with other higher institutions of learning, exercises the high privilege of conferring honorary degrees upon men who have, by work done outside as well as inside of college walls, proved their right to be acknowledged as men of eminent intellectual attainment. While it is a great privilege to be authorized to so seek out and honor those who have proved themselves worthy, it is a privilege not lightly to be exercised. That Stevens Institute has not misused its privileges in this connection is indicated by the fact that during the past thirty-two years we have graduated 1,089 men; but we have, during the same time, conferred only 15 honorary degrees. This year the faculty and trustees have decided to confer for the first time the honorary degree of Doctor of Science. I present for the honorary degree of Doctor of Science Edward Weston, Doctor of Laws of McGill University, Toronto, original investigator in science, inventor and engineer.

"This is frequently spoken of as the age of electricity, and this because during the past few decades the manifestations of electricity have been studied until it has been possible in many marvelous ways to apply for the use and benefit of mankind the laws of nature so discovered. In so discovering and applying the laws of electrical science, probably no one has done more for mankind than Edward Weston. Many years ago he made radical improvements in the art of depositing the various metals by electricity. He developed the dynamo machine to take the place of batteries in this work. H took the lead in the work of investigating the separate losses in dynamo machines and his inventions served to greatly reduce tho e losses. He developed dynamo machines for electric lighting and power transmission. He built the first factory in the United States for manufacturing dynamo machines and in this factory the electric current was first used for transmitting power. He invented processe , machines and devices for arc and incandescent lighting, including the copper-coated carbon, carbon filaments from amorphous cellulose, and the hydro-carbon treatment now universally used for flashing incandescent lamp filaments.

"In later years he discovered two alloys having a zero temperature coefficient, now universally used for resistance standards. He invented a standard cell with a practically zero temperature coefficient, and he invented and developed a most complete line of direct indicating electrical measuring instruments which to-day are the standards throughout the civilized world. It is seldom that the ability to carry on work in the line of scientific research is found combined with the ability to practically apply the laws so discovered as is found in the person of Mr. Weston. In acknowledgment of the varied, original, important and great amount of scientific work he has accomplished, the record of which I have barely outlined, I ask you to confer upon Edward Weston the degree of Doctor of Science."

Another interesting part of the exercises was the address to the graduating class by Mr. Walter C. Kerr, a trustee of Cornell University, and president of Westinghouse, Church, Kerr & Co., who with wonted felicity and suggestiveness spoke of the importance of "The Point of View." He called attention to the fact that the so-called liberal education had always been highly academic, while trade school engineering had been strictly non-academic. But the two had joined hands in the engineering institutes, with advantage; but there was a danger of engineering education now becoming too academic, a tendency to be watched. He asserted that the highest refinement of knowledge follows from the highest use of the senses. "It is only within the past century that the human mind has seemed capable of turning from the lesser resistance of intellectual attainment to the greater capacity for physical comprehension and observation. We have but recently come to the era of intense mental operations, dealing with laws and principles which require insight greater than the intellect can grasp unless aided by the senses." He expressed the hope that the spirit of engineering as found in practice would form a more definite part of engineering education, and suggested the idea that professors would eventually come to a system of devoting all their time to teaching while they taught, but would go periodically into the world, a few years at a time, for practice.

Mr. Kerr then speaking more directly to the students, urged on them the importance of the right "point of view" as they began active life and went through it. Adam, William Tell and Sir Isaac Newton each had an affair with an apple, but with different results. They were to neglect no opportunity as too small, and were to remember that knowledge after all had not much to do with effectiveness. It was a good tool, but not the performing vital form. They must cultivate singleness of purpose. The power of concentration, however, is not in the books. From directness of purpose follows diligence in getting what one is after, and in getting it all. The mediocrity of compromise was to be avoided. To be right they must be 100 per cent. right. Much of our engineering is only done once, and it must be done right that once. Real power is ability to perform right the first time that which a man never did before. Hence, by sequence, clearness of thought is also essential, aided by the moderate cultivation of system, without slavery to which each can find his own logical way. Intuitions were thus quick reasonings, but all ideas little or big were only valuable when put into execution. A point of view is involved in the power to rationalize, which is in itself a great check upon error.

Mr. Kerr enlarged quite interestingly also upon the "point of view" in engineering expression—designs, drawings, mathematical determinations, words, work done, of which words were the lamest. Hence, he urged learning the right use of words, for engineering documents were usually full of misstatements due to the careless use of language, so that plain, concise terms could not be overestimated. Facility was to be cultivated in reading the words of others. Per contra, one of the worst attributes, fundamentally born of conceit, was the tendency to fasten error and censure on others. A man needed to stand up in front of himself and ask, "What is the matter with me?" To admit an error or frailty of judgment is a measure of strength rather than weakness. Mr. Kerr then lay special stress on a cheerful disposition, pleasantry and non-contentiousness, because a reasonable optimism—to vote aye and believe that things can be done—is helpful to others and to enterprises.

Some of them probably had a special "point of view" in a preconceived notion of following some line of engineering. He warned them to be careful about their self-analysis. The field of engineering is large and has room for all, whether constructive, inventive or contemplative. Some tended toward professional, others toward trade work. He could not help, for himself, a certain predilection in favor of a young man being just an engineer—not specializing too young, but developing along versatile lines, ready to turn his hand equally well to any task within his general scope. The man who believes he can apply himself in one direction about as well as another, will come nearer doing it than one who thinks he cannot. They would also doubtless try to improve things when they started. It is a legitimate purpose if not overworked. The one improvement that most things needed was in the line of sufficiency. A "point of view" rarely considered had to do with environment and the power to vary. All the way up from protoplasm, environment grew constantly more intricate and resistance retarded evolution. This complexity presses down and holds back. Environment was not a producer, but often against production, so that all the good they did must come out of themselves. It was the inherent capacity to perform with their own brain that would make them whatever they became and not the mere transmission of what they had acquired. Many a man who had received an education has not got any, because it never became part of his personality and slipped away. Many a man had gone through experience without acquiring it.

Bear River Power Plant and Utah Transmission Systems—II.

(*Concluded.*)

FROM the power house the three-wire transmission line passes up the east bank of the river and skirts the base of the Wasatch Mountains, keeping for the most part above the cultivated farms. It taps into the Utah Light & Railway Company's line at Ogden. The total transmission distance from the power house to Salt Lake City is 82 miles and the route of the line is shown on the map, Fig. 17, to which reference will be made later.

The transmission line consists of three No. 0 soft-drawn copper wires, carried on 40-ft. round cedar poles set 120 ft. apart. The insulators are carried on two cross arms, as shown in Fig. 12. The lower arm, which carries two wires, is 7 ft. long and is bolted to the pole 5 ft. below the top. Additional support to the arm is provided by two 30-in. x 1¼-in. x ⅜-in. iron braces, fastened with lag

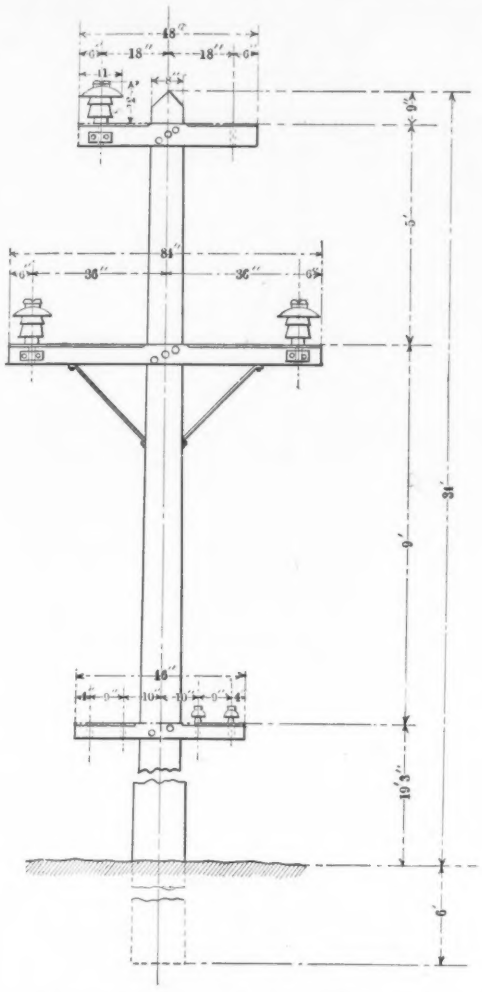


FIG. 12.—ELEVATION OF 40-FT. POLES.

screws. The top insulator, instead of being mounted on the top of the pole, as is frequently done in the West, is carried by a 4-ft. cross arm bolted to the pole 9 in. below the top, thus giving a better mechanical construction. Both cross arms are 3¾ in. x 5¾ in. in cross-section. The top insulator is mounted 18 in. from the center of the pole and on successive poles is reversed from one end of the arm to the other, as may be seen in Fig. 12. This arrangement is an advantageous one in case of a broken insulator, as the wire will fall on the cross arm and against the pole and thus be kept from causing a short-circuit by falling on the wires below. The three wires, of course, are not spaced to form an exact equilateral triangle, but it is an approximate one, with 6-ft. sides.

In the construction of the pole line the insulators have been relied upon entirely for insulation and the rest of the line has been made as strong mechanically as possible. The insulators are of the Locke brown porcelain type, made in three pieces and afterward cemented together. Each insulator was tested at the factory with a 120,000-volt current before being accepted. The insulators are 10 in. high, 11 in. in diameter and weigh sixteen pounds apiece. They are mounted on cast-iron pins, which have a height of 10 in. above the cross arm and are threaded at the top to receive the insulator. The cast-iron

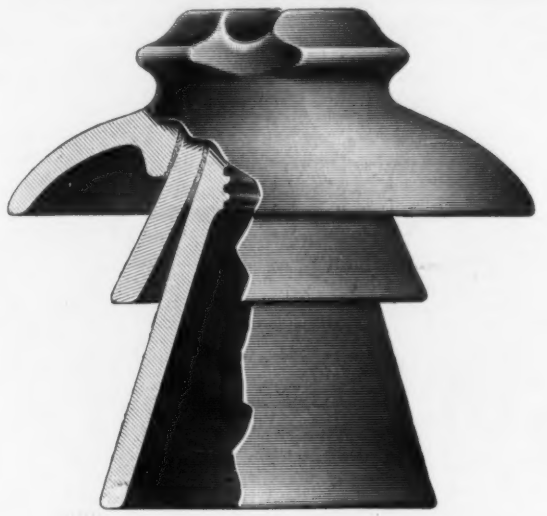


FIG. 13.—PORCELAIN INSULATOR.

shank of the pin is 1¼ in. in diameter and 5 in. long, and has a ⅝-in. round steel core, which projects below and is threaded to receive a nut for bolting the pin securely to the cross arm. Further security is provided by 3 x 4 x ⅛-in. plates bolted to the sides of the cross arms opposite the pins.

Fig. 13 shows the insulator used. The middle and lower shells were cemented together at the factory, and the top shell cemented on in the field. Fig. 14 shows an insulator under test at 75,000 volts with

FIG. 14.—INSULATOR UNDER TEST AT 75,000 VOLTS.

a shower of water corresponding to a precipitation of ¾ in. per minute, the test covering 15 minutes. The standard test under normal conditions is at 100,000 volts.

Nine feet below the large cross arm is a 46-in. cross arm which carries a No. 9 iron-wire telephone circuit. The telephone line is transposed every half mile and is said to give perfectly quiet service, although there is an induced voltage between either side and ground sufficient to light an incandescent lamp. For the use and convenience of the men patrolling the line, telephones are connected at intervals along the route as well as at the power house and receiving station in Ogden. They are placed in booths so insulated as to protect the user from danger of an accidental cross between high-tension and telephone wires in case of a breakdown.

The entire output of the Bear River plant of nearly 3,000 hp is sold by the Utah Sugar Company to the Utah Light & Railway Company, as already mentioned, and the latter company operates the station and transmission system. It has recently been decided to

install a third unit at the power house of the same size and style as those now in operation.

The concrete work and power house were built under the direct superintendence of Mr. J. C. Wheelon, superintendent of the Utah Sugar Company's canal system. The entire plant and transmission system was designed and supervised by Hayward & Gray, consulting engineers of Salt Lake City. To Mr. O. H. Gray, successor to the firm of Hayward & Gray, appreciation is due for kindly supplying data and illustrations for this article.

NOTES ON UTAH TRANSMISSION LINES AND SALT LAKE STATIONS.

A general idea of the extensive interconnected power transmission

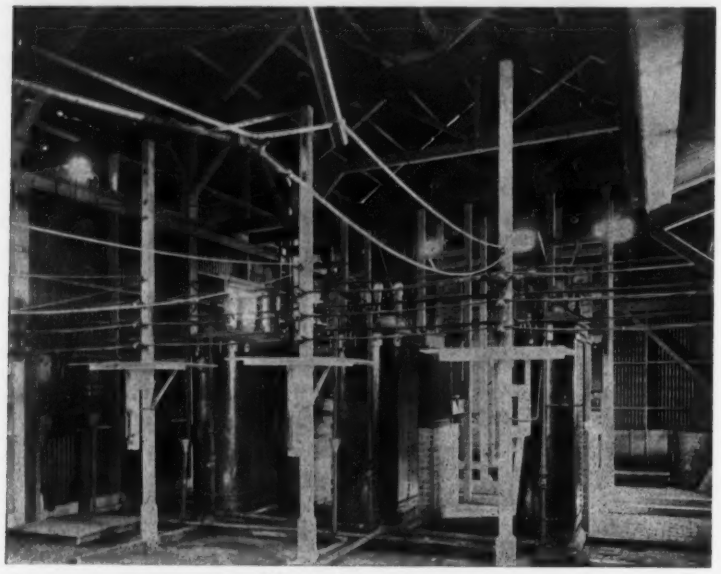


FIG. 15.—INTERIOR OF SUB-STATION, SHOWING HIGH-TENSION BUS-BARS, TRANSFORMERS, ETC.

system in Utah may be obtained from the map, Fig. 17. This map shows the lines of the Utah Light & Railway Company, including the Bear River system, indicated by a heavy, full line, the circuits of the Telluride Power Transmission Company indicated in heavy broken lines and the system of the American Fork Canyon plant in crossed lines.

The Utah Light & Railway Company operates the Bear River, Ogden and two Cottonwood water power plants and three steam stations in Salt Lake City. The Telluride company has a water power

FIG. 16.—INTERIOR OF SUB-STATION, SHOWING LIGHTNING ARRESTERS, ETC.

plant at Logan, 85 miles north of Salt Lake City, and another at Provo, 45 miles south. These two stations are connected by a duplicate pole line and at Salt Lake taps are taken off to a transmission sub-station of the Utah company situated close to a new station of the company in the western part of the city. At this station the power from the Telluride system and the company's northern lines

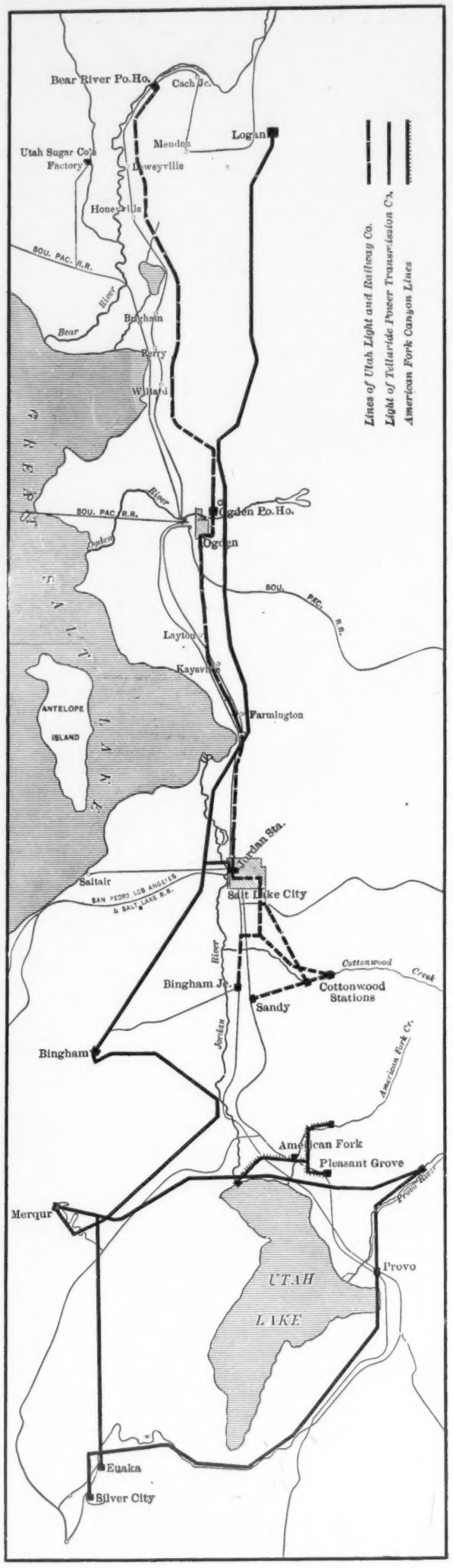


FIG. 17.—MAP OF TRANSMISSION SYSTEMS.

is received and stepped down from 40,000 to 2,300 volts by means of water-cooled, oil-insulated transformers. This sub-station now has a capacity of 2,700 kw, but it is being rebuilt and enlarged and by fall will have a capacity of 6,000 kw and will receive the power from all the transmission lines of the company, including those from the Cottonwood stations, which now come into another sub-station at a lower voltage. The sub-station is equipped with lightning arresters, static interrupters, air-break switches and a complete set of indicating and recording instruments.

The steam station is called the Jordan station, as it is located on the bank of the Jordan River. It was erected as a temporary power house to carry the company through its peak loads until a large steam turbine central station now planned by the company can be erected. The equipment consists of six 250-hp Babcock & Wilcox boilers set in three batteries, and a 1,200-hp Hamilton Corliss engine, which drives by means of a large belt a 750-kw alternator. This plant is used for a few hours each night to help over the peak of the load.

It is interesting to note that these six water power and three steam stations are all operated in parallel through the low-tension side, and although some of the stations are nearly 150 miles apart the generators operate in perfect synchronism.

Fig. 18 is interesting as showing how a high-tension transmission line from the Cottonwood plants is brought through Fourth South

FIG. 18.—HIGH-TENSION LINE, SALT LAKE CITY.

Street, one of the principal streets of Salt Lake City, on 60-ft. poles. These poles are set in the center of the street, as are practically all poles in the city on account of the unusual width of the streets.

An interesting transmission system in Utah is that from American Fork Canyon to Utah Lake and indicated on the map by crossed lines. This system is a striking illustration of the use of water power as an aid to irrigation. The power in this case is transmitted electrically to the head of Utah Lake, where it is used to drive four 100-hp pumps, which raise about 500 cu. ft. of water per second out of the lake into a system of five large canals. These canals irrigate the Salt Lake Valley. Power for the pumps was formerly supplied by the Jordan Narrows plant, but the American Fork plant has recently been enlarged and the transformers at the pumping plant have been rearranged for this purpose. The reconstruction work was done by Mr. Owen H. Gray.

Deep Sea Cable Between Valdez and Nome.

The second consignment of deep sea cable now being laid by the Government between Valdez and Nome has just been shipped in a special train of thirty-one cars over the Lackawanna Railroad. This shipment consists of 800 tons, and is part of an order for thirteen hundred miles of submarine cable being executed by the Safety Insulated Wire & Cable Company.

An Object Lesson to the Public in Metering.

An interesting piece of apparatus for the instruction of the general public in regard to electric light meters is in operation at the main office of the Denver Gas & Electric Company, on Seventeenth Street, Denver, Colo. The device consists of eight incandescent lamps mounted in porcelain sockets on a wooden panel about 25 in. square; an electric meter and eight snap switches. The lamps are wired to the regular 100-volt alternating circuit of the company and are numbered consecutively from one to eight. The first and eighth lamps are 4 cp each, while the candle-power of the intermediate lamps is 8, 10, 16, 25, 32 and 50 in the order named. Each one or any number of these lamps may be switched into circuit at the will of any customer desiring to experiment with the meter. The snap switches are numbered consecutively to correspond with the different lamps and are mounted in a horizontal row at the bottom of the board. A great number of candle-power combinations are thus possible for experimental purposes, and these vary from 4 to 149 cp. Even the effect of one candle-power may be noted by combining the lamps properly.

The meter is a 100-volt, 10-amp. watt-hour instrument mounted in a glass case, and designed for 60-cycle current. It is direct reading and has a dial capacity of 100,000,000 watt-hours. The brake disc is marked at a point on the circumference so that the revolutions may be accurately tuned and counted. In the center of the panel is a notice to the public as follows:

"THIS IS AN ELECTRIC METER"

like those which are in the houses and stores of our customers, except that this one is constructed partly of glass in order that you may see how an electric meter is made and how it operates. This particular meter measures the current that supplies the lamps on the board surrounding it. By turning on one lamp at a time or by turning on lamps of different candle-powers you can see that the motion of the moving parts of the meter varies in proportion.

"An electric meter is an almost perfect measuring instrument. It measures current with great accuracy. We test all our consumers' meters at frequent intervals to see that they are registering correctly, and then abide strictly by their readings in making out our consumers' bills.

"We have no control over the size of our consumers' electric bills. That is a matter which rests entirely with the consumers themselves. We cannot make their bills larger or smaller unless we should go into their houses and turn on or off some of their lamps. If the consumer thinks his bill is too large we are glad to do all we can toward helping him ascertain the facts in the case. If he thinks his meter is incorrect we shall be glad to take his meter out and test it in his presence. If the test shows that the meter has been registering against him we will rebate him accordingly.

"We are especially desirous that our customers should learn to read their own meters so that they may verify the correctness of our bills and keep tab on their consumption of current from time to time during the month. The reading of an electric meter is as easy as telling the time of day by a clock. You simply begin with the left-hand dial and set down in turn the smaller of the two figures between which the "hand" on each of the dials appears and then add two ciphers. This will give you the reading in watt-hours, and, pointing off three places from the right gives it in "kilowatt-hours." Subtracting the previous reading from this one will show how much current has been consumed since the previous reading. Please ask us for a copy of our printed instructions for reading meters.

DENVER GAS AND ELECTRIC COMPANY."

At the right of the lamp panel is a gas meter connected to six different sized burners, a similar notice being posted upon the board over the meter, designed for the reading of gas consumers.

The printed instructions for reading electric meters consist of a sheet of cardboard about 5 by 7 in. upon which are inscribed regular meter dials with movable hands, so that various readings may be set up at will. Full directions follow the printed dials, and the card is fitted with eyelets and a hook, so that it may be used as a bill file.

By means of this object lesson the Denver Company meets its consumers frankly and squarely upon the hitherto vexing meter problem.

Foucault Pendulum Systems.

BY ERNEST K. ADAMS.

IN a preceding issue of this journal* a number of electrical systems have been illustrated and described, whereby the vibrations of a Foucault pendulum may be prolonged. These systems are based upon the electrodynamic action of two coils of different diameters, the smaller of which is incorporated in the bob of the pendulum and the larger mounted symmetrically beneath the said pendulum. By simultaneously sending currents through these coils in the same or opposite directions, the pendulum coil may be accelerated respectively toward or away from the center of the large coil. The methods of controlling the accelerating current may be manual or automatic. From a test made with a 16-ft. pendulum, the results obtained would indicate that the principles of the systems are correct. The burden of the paper was to suggest a line of investigation in this subject to those who have the facilities for swinging pendulums whose lengths may run up to that of the original one in the Pantheon at Paris. In a recent communication to the ELECTRICAL WORLD AND ENGINEER, Mr. S. Tideman suggests that the pendulum may be accelerated by raising and lowering the suspension of the

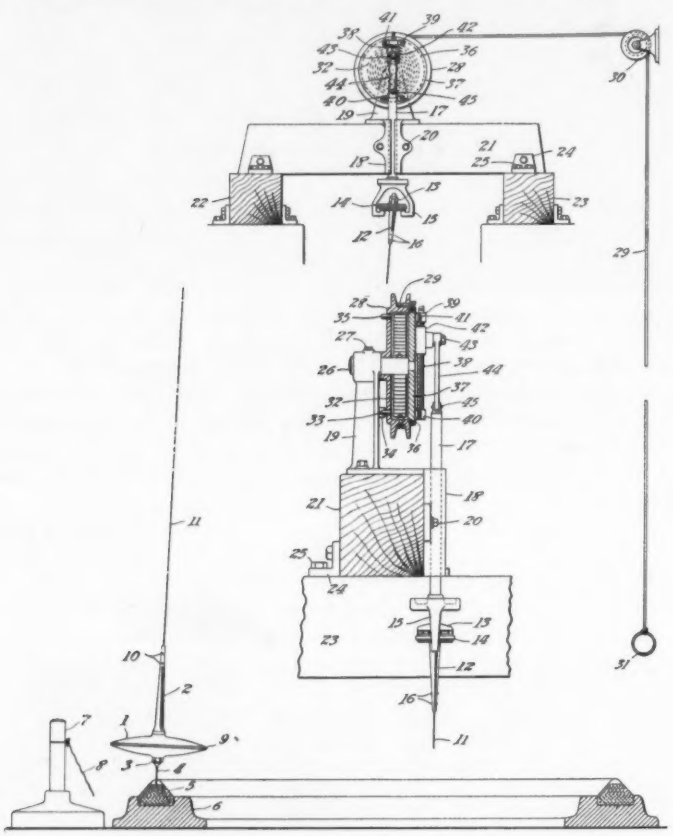


FIG. I.—MECHANICAL SUSPENSION TYPE OF FOUCAULT PENDULUM.

system when the bob of the same is traveling respectively away from and toward a vertical line passing through the point of suspension. While it is known that the suspension of a Foucault pendulum is the most sensitive portion of the organization, it may be possible to so accelerate it there that the component of the earth's rotation will not be seriously influenced in its action upon the pendulum. In the present paper the writer begs to suggest several designs for carrying out this idea. The first is a mechanical one, which is adapted to pendulums of moderate length, such as would be employed in general physical laboratory work, while the others are electrical in character and suitable for pendulum systems of considerable height, as would obtain in the Pantheon or other demonstrations. In all cases the movement of raising and lowering the suspension is caused to imperceptibly start and stop, the maximum rate of vertical motion occurring at the center of the predetermined displacement.

MECHANICAL SUSPENSION TYPE.

The suspension of the pendulum is designed to be given its reciprocating travel by means of a drum, link and plunger combination, which is operated by drawing a cord when the pendulum is moving toward the center of its amplitude and slowly releasing the aforesaid cord during the outward passage of the pendulum. The cord may extend from the suspension mechanism down to the operator upon the floor below, irrespective of the length of the pendulum. The length of stroke of the suspension may be adjusted to suit any pendulum of moderate length, thereby adapting a given size of the apparatus to a majority of cases.

A diagrammatic view of the arrangement is shown in Fig. 1.

The pendulum consists of a disc-shaped bob, 1, having a post, 2, secured therein by a hexagonal nut, 3. Threaded into the lower extremity of the post, 2, is a fine needle, 4, which is adapted to make furrows through the top of a pointed heap of sand, 5, placed in a wooden ring, 6. This ring, 6, is mounted symmetrically beneath the pendulum system. The top of the ring, 6, is provided with angular graduations. A weighted standard, 7, is furnished for maintaining the bob, 1, at one side, preparatory to setting the pendulum in vibration by burning a thread, 8, in the customary manner. A small depression, 9, is turned in the periphery of the bob, 1, for enabling the thread, 8, to be conveniently tied around the said bob, 1. Held by a number of screws, 10, in the post, 2, is a steel wire, 11, which extends upward to a knife-edge suspension made up of a post, 12, knife-edged member, 13, rocking ring, 14, and knife-edged supporting member, 15. The wire, 11, is secured in the post, 12, by several screws, 16. The supporting member, 15, is threaded upon the lower extremity of a rectangular plunger, 17, which is adapted to move in an accurately planed guide, 18. For preventing oil from the guide, 18, from running down the wire, 11, a groove is turned in the top of the supporting member, 15.

The guide, 18, forms a part of a journal casting, 19, which, together with the aforesaid guide, 18, is rigidly secured by several bolts, 20, to a wooden beam, 21. This beam, 21, rests upon two wooden supports, 22 and 23, the three members being secured together by a number of angle irons, 24, and bolts, 25. Journaled upon a shaft, 26, which is held in the casting, 19, by a set screw, 27, is a drum, 28, around the periphery of which is wound a cord, 29. This cord, 29, is secured to the drum, 28, by tying a knot in it, and passes over a pulley, 30, which is fastened to any convenient support. The cord, 29, is terminated by a ring, 31, at any desired height from the floor. A helical spring, 32, is secured to both the shaft, 26, and the interior of the drum, 28. This spring, 32, normally maintains a pin, 33, let into the face of the drum, 28, against a rubber-covered stop, 34, mounted upon the casting, 19. For limiting the angular motion of the drum, 28, to one-half a turn, a second pin, 35, is let into the side of the aforesaid drum, 28. Secured by several screws, 36, to the front of the drum, 26, is a disc, 37, upon which a threaded shaft, 38, is journaled by two bearings, 39 and 40. A number of screws, 41, serve to hold the bearings, 39 and 40, in place. Mounted upon the threaded shaft, 38, is a member, 42, having secured thereto a bolt, 43, which journals a link, 44. The lower end of the link, 44, is journaled in the top of the plunger, 17, by a pin, 45.

Presupposing that the apparatus has been set up, the bob, 1, tied by the thread, 8, in the plane of the meridian, and the threaded shaft, 38, adjusted until the right eccentricity of the bolt, 43, is obtained for accelerating the pendulum system, the thread, 8, is burned and the pendulum thereby set in vibration. With each oscillation of the pendulum the needle, 4, will make an indentation in the sand, 5, and the angular change of the plane of vibration of the system will be thereby recorded. When the amplitude of the oscillations of the pendulum are noticed to be decreasing below that desired, the cord, 29, may be drawn down and the drum, 28, revolved through one-half a revolution while the bob, 1, is traveling inward. On account of the construction of the apparatus, the suspension during this motion of the drum, 28, will be caused to move downward through the predetermined displacement, beginning and ending its motion slowly and attaining a maximum rate in the center of its stroke. This action will give the pendulum an acceleration. Upon the bob, 1, now traveling outward, the cord, 29, may be slowly released, the drum, 28, being turned by the helical spring, 32, in the opposite direction to that just previously occurring, thereby lifting the suspension and giving the pendulum another acceleration.

This cycle of operations may be repeated until the amplitude of the vibrating system has been restored to that desired. After several trials the motion of the cord, 29, may be readily kept in step with the oscillations of the pendulum. By following the path of the needle, 4, over the graduations on the top of the ring, 6, or

*See ELECTRICAL WORLD AND ENGINEER, January 30, 1904, p. 211.

comparing the indentations made by the needle, 4, in the sand, 5, with the aforesaid graduations, the number of degrees angular variation of the pendulum's plane may be noted. If the pendulum should be mounted at either of the poles of the earth, the plane of oscillation would appear to make one complete turn in 24 sidereal hours. At the equator there should be no relative motion between the pendulum's plane and the earth. For intermediate points between the poles and the equator, the rate of revolution is proportional to the sine of the latitude of installation, the angle turned through in one hour being equal to 15 degrees multiplied by the sine of the latitude. The rotation of the plane is clockwise and anti-clockwise from above for northern and southern latitudes, respectively. For the latitude of New Haven, Conn., the hourly variation of the plane should be 9.903 degrees, or one complete revolution in 36.35 hours. In New York City the angular change should be 9.801 degrees per hour or one turn in 36.73 hours. It is hardly to be expected that these values can be exactly obtained experimentally. The best results will be obtained when the pendulum wire is of considerable length, the suspension rigidly mounted and the influence of air currents eliminated.

ELECTRICAL SUSPENSION TYPES.

The present Foucault pendulum systems are intended to be electrically operated, the methods of control being either manual or automatic. The reciprocating rectilinear movement of the pendulum's suspension is produced from circular motion by the same device as shown in Fig. 1. An electric motor is provided for continuously driving this mechanism in synchronism with the vibrations of the pendulum. A clockwork drive may be employed for this purpose, but on account of the necessity of having to frequently wind it up, it is believed preferable, particularly in a large pendulum system, to provide a continuously revolving motor. The motor is run at a fairly constant speed, and is allowed to operate the suspension whenever a releasing magnet is energized. The circuit of this releasing magnet is designed to be either manually or automatically closed in several ways by the pendulum at certain points of its amplitude. The first method shown consists in allowing the pendulum's needle and a stationary metal ring to form the terminals of the secondary circuit of a high-potential transformer. The primary of the transformer includes the releasing magnet and a suitable source of alternating current. When the pendulum is at the end of its swing, a series of sparks are allowed to pass through the small air-gap between the pendulum's needle and the metal ring, thereby temporarily closing the secondary circuit, increasing the current in the primary and operating the releasing magnet. By this method of control there need be no material contact with the pendulum system. In the second design the circuit of the releasing magnet is periodically closed by employing some electrically conductive substance such as graphite for the pendulum's needle to record the angular change of the plane of oscillation in. The employment of graphite thereby serves a double purpose. In the third illustrated method of control, the circuit of the releasing magnet is closed at intervals by a mercury contact.

By referring to the drawings, Fig. 2 is a diagrammatic scheme of the electrical pendulum system, Fig. 3 a wiring diagram of the modified method of controlling the automatic accelerating action by providing a conductive substance for the pendulum's needle to pass through, and Fig. 4 a detail of the mercury contact for the same purpose.

The construction consists of a pendulum wire, 46, which is fastened by several screws, 47, to a post, 48. This post, 48, passes through a disc-shaped iron bob, 49, and is secured therein by a hexagonal nut, 50. A fine needle, 51, is threaded into the lower end of the post, 48. The upper extremity of the pendulum wire, 46, terminates in a knife-edge suspension, which is made up of a central post, 52, knife-edged portion, 53, rocking ring, 54, and supporting knife-edged member, 55. The wire, 46, is secured in the post, 52, by several screws, 56. The supporting member, 55, is threaded upon the lower extremity of a plunger, 57, which is guided in a tube, 58. The tube, 58, passes through a wooden beam, 59, and a journal casting, 60, the said tube, 58, being held in place by a hexagonal nut, 61, and the casting, 60, secured by several bolts, 62. The plunger, 57, is prevented from turning by a pin, 63, which extends through the tube, 58, and a slot, 64, milled in the aforesaid plunger, 57. The beam, 59, rests upon two wooden supports, 65 and 66, the three members being fastened together by several angle irons, 67, and bolts, 68. The supports, 65 and 66, in turn are fastened in place by a number of angle irons, 69, and bolts, 70. A casting, 71, is pinned to a shaft, 72, which is journaled in the main casting, 60. Mounted in two extensions from the casting, 71, and secured therein by a bushing, 73, is a threaded shaft, 74. The upper extremity of the shaft, 74, is provided with several holes, 75, for enabling a close adjustment to be made. Mounted upon the shaft, 74, is a member, 76, having threaded therein a bolt, 77, which serves to journal a link, 78. The lower extremity of the link, 78, is journaled by a pin, 79, in the upper end of the plunger, 57. A mechanical combination is situated adjacent to the suspension for revolving the shaft, 72, with each vibration of the pendulum.

This arrangement consists of a journal casting, 80, which is fastened by several bolts, 81, to a wooden block, 82, in turn secured in place by several angle irons, 83, and bolts, 84. Journaled in the

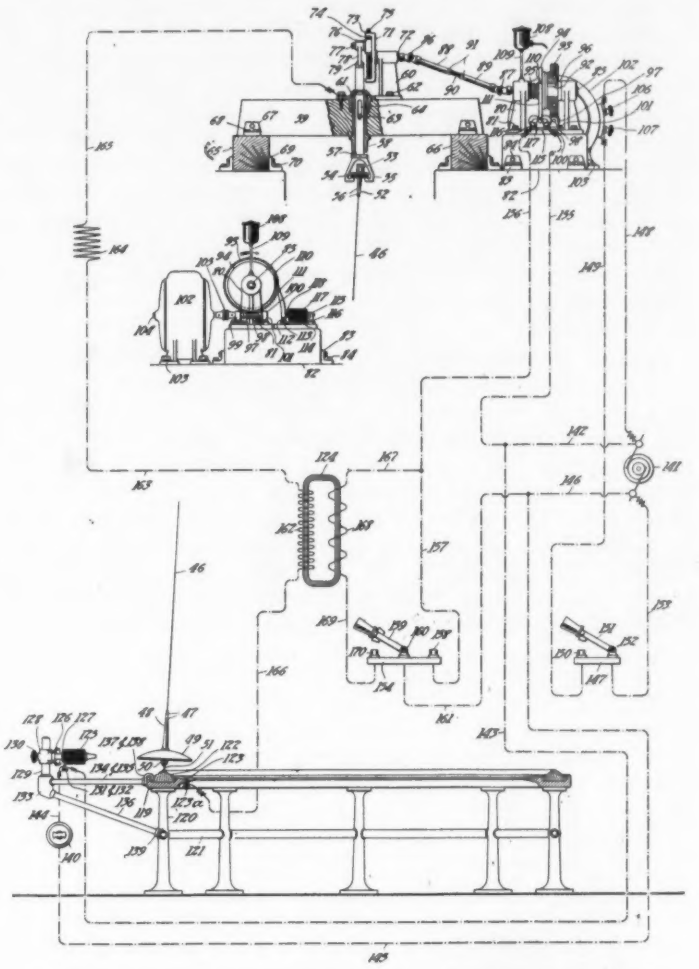


FIG. 2.—ELECTRICAL SUSPENSION TYPE OF FOUCAULT PENDULUM.

casting, 80, is a shaft, 85, which is mechanically connected with, but insulated from, the other shaft, 72, through the medium of two universal couplings, 86 and 87, tubes, 88 and 89, fibre joints, 90, and pins, 91. Secured upon the shaft, 85, by a key, 92, is a worm gear, 93. The left-hand side of the worm gear, 93, is adapted to form a friction clutch in connection with a disc-shaped member, 94, which is both journaled upon the shaft, 85, and maintained against the worm gear, 93, by a compression spring, 95, situated between the aforesaid disc, 94, and the journal casting, 80. A roller thrust bearing, 96, is placed between the worm gear, 93, and the journal casting, 80. A worm, 97, mounted upon a shaft 98, which is journaled in two bearings, 99 and 100, secured to the main casting, 80, by a number of screws, 101, meshes with the worm gear, 93. An alternating-current motor, 102, is secured by a number of bolts, 103, adjacent to the wooden block, 82, and the shaft, 104, of the aforesaid motor, 102, is connected with the worm shaft, 98, by means of a pin and slot coupling, 105. The terminals of the motor, 102, are numbered 106 and 107. An oil reservoir, 108, is mounted upon the journal casting, 80, by a standard, 109, the purpose of which reservoir, 108, being to lubricate the friction clutch.

Formed upon the periphery of the disc, 94, is a tooth, 110, which, by the rotation of the worm gear, 93, is maintained against the

extremity of a lever, 111, journal in a casting, 112, secured to the main casting, 80, by several screws, 113. The top of the lever, 111, is maintained against the circumference of the disc, 94, by a retractile spring, 114, the right-hand end of which is fastened to a support, 115. The support, 115, which is secured to the main casting, 80, by two screws, 116, serves to mount an electromagnet, 117. An armature, 118, is secured to the lever, 111, adjacent to the poles of the electromagnet, 117. It will be understood that when the electric motor, 102, is running, the disc, 94, will be normally prevented from revolving, the worm gear, 93, rotating independently of the aforesaid disc, 94. When, however, the electromagnet, 117, should be temporarily energized, the upper extremity of the lever will be moved away from the tooth, 110, and, by reason of the friction drive, the disc, 94, will be allowed one complete revolution. With this movement the suspension will be lowered and raised in its accelerating function. The amount of work consumed at the friction clutch when the worm gear, 93, is revolving and the disc, 94, stationary, should be more than the work required to turn the suspension shaft, 72. The power of the motor, 102, should be considerably more than that required to overcome the friction between the worm gear, 93, and disc, 94, in order that there will be no appreciable variation in the speed of the aforesaid motor, 102, when the disc, 94, is revolving or stationary. The speed of the motor, 102, is also so chosen and the worm gearing so proportioned that in the normal running of the aforesaid motor, 102, the disc, 94, will make, when magnetically released, one complete turn in approximately three-quarters or seven-eighths of the time of one oscillation of the pendulum.

Situated symmetrically beneath the pendulum system upon the floor is a wooden ring, 119, which is made in sections and supported by a series of iron posts, 120, and tubes, 121. The wooden ring, 119, is provided with a groove in which sand, 122, is placed. Secured to the inner surface of the ring, 119, is a metal annulus, 123, which is made in sections, and forms one of the terminals of the secondary circuit of a high-potential transformer, 124. The pendulum's needle, 51, performs the function of the other terminal of the secondary circuit of the transformer, 124. A binding post, 123A, is secured to the metal ring, 123. The outer surface of the ring, 119, is provided with angular graduations. A magnetic device is furnished for starting the pendulum in vibration. This arrangement consists of an electromagnet, 125, which is lightly journaled by two pointed screws, 126 and 127, in a casting, 128, maintained in any desired vertical position upon a standard, 129, by a knurled headed screw, 130. The terminals of the magnet, 125, are fastened to two binding posts, 131 and 132, which are mounted upon one end of the aforesaid magnet, 125. The standard, 129, is threaded into a casting, 133 in which three tubes, 134, 135 and 136, are secured. The tubes, 134 and 135, are terminated by two hook-shaped castings, 137 and 138, respectively, which are adapted to engage the circumference of the ring, 119. The lower end of the tube, 136, is provided with a casting, 139, which is so shaped as to rest upon one of the tubes, 121. It will be evident that the bracket thus formed may be moved to any desired position around the wooden ring, 119.

The operation of starting the pendulum system in vibration, presupposing that the apparatus has been carefully set up and the threaded suspension shaft, 74, adjusted to the correct position for accelerating the pendulum, consists firstly in moving the starting magnet, 125, around until the center of the ring, 119, and the said magnet, 125, are in the plane of the meridian. The pendulum bob, 49, is now brought up to the poles of the magnet, 125, and the said magnet, 125, energized by closing a switch, 140, which allows electricity to flow from a source, 141, of alternating current through a circuit made up of two wires, 142 and 143, binding post, 131, magnet, 125, binding post, 132, conductor, 144, switch, 140, together with the wires, 145 and 146. The sand, 122, in the ring, 119, is now pointed with a piece of cardboard. When desired the switch, 140, is opened, and the magnet, 125, now being without magnetism, the bob, 49, will be released and the pendulum set in vibration. The needle, 51, will now begin to chisel small furrows through the sand, 122. The induction motor, 102, is next started by closing a switch, 147, which completes a circuit made up of the source, 141, wire, 148, binding post, 106, motor, 102, binding post, 107, conductor, 149, clip, 150, switch blade, 151, journal post, 152, and wire, 153. When the motor, 102, has attained its normal speed the manual or automatic acceleration of the pendulum system may begin.

The manual acceleration is accomplished by closing over to the right-hand side for an instant a switch marked 154, when the pendulum bob, 49, is at the end of its amplitude. This action allows current from the source, 141, to flow through a circuit consisting of the wires, 142 and 155, releasing magnet, 117, conductors, 156 and 157, clip, 158, switch blade, 159, journal post, 160, together with the wires, 161 and 146. The magnet, 117, now attracts the armature lever, 111, which moves out of the path of the tooth, 110, thereby allowing the worm gear, 93, to revolve the disc, 94, for one turn, and giving the suspension of the pendulum a gentle downward motion while the bob, 49, is traveling inward and a corresponding upward displacement during the outward passage of the aforesaid bob, 49. On account of the speed of the motor, 102, being chosen such that the disc, 94, requires approximately seven-eighths of the time of one beat of the pendulum, the vertical motion of the suspension will cease when the bob, 49, is just about at the end of its outward swing. This will give sufficient time to again temporarily close the switch, 154, before the bob, 49, begins its return motion, at which time the same accelerating cycle will be repeated. The pendulum system can be constantly accelerated in this manner or periodically depending upon the adjustment of the threaded shaft, 74. As in the mechanical form of apparatus already described, the beginning and ending of the vertical stroke of the suspension plunger, 57, is gradual, the maximum rate of travel taking place at the middle of the stroke. This method of acceleration should not disturb the normal action of the vibrating system.

For the automatic operation of the pendulum, the threaded shaft, 74, should be so regulated that, when the system is constantly accelerated the bob, 49, will terminate its travel a short distance outside of the circular bank of sand, 122. Presupposing that the pendulum system has been set in motion in the plane of the meridian by the starting magnet, 125, the motor, 102, is running, and the amplitude of the pendulum has been allowed to decrease until the needle, 51, stops just outside the sand, 122, the blade, 159, of the switch, 154, is closed over to the left-hand side when the bob, 49, is in the middle of its swing. Upon the needle, 51, slowly passing over the metal ring, 123, as the pendulum is about to terminate its outward swing, the secondary of the transformer, 124, will be closed and a succession of sparks will pass through the small air-gap between the needle, 51, and ring, 123, the circuit consisting of the transformer secondary winding, 162, wire, 163, non-inductive resistance, 164, conductor, 165, suspension apparatus, pendulum wire, 46, post, 48, needle, 51, ring, 123, binding post, 123A, and conductor, 166.

This closing of the secondary has increased the current in the primary circuit, which is made up, from the source, 141, of the wires, 142 and 155, releasing magnet, 117, conductors, 156 and 167, primary transformer winding, 168, wire, 169, clip, 170, switch blade, 159, journal post, 160, together with the conductors, 161 and 146. With the increase of current in the primary circuit, the magnet, 117, has been energized and the disc, 94, allowed to slowly rotate, thereby giving the pendulum an acceleration during the ensuing return oscillation, the speed of the motor, 102, being so regulated that the turning of the disc, 94, will stop when the bob, 49, is within a short distance of the metal ring, 123. It will be noted that when the bob, 49, started its return motion the needle, 51, again passed over the metal ring, 123. This action caused the releasing magnet, 117, to be again energized and the lever, 111, moved away from the periphery of the disc, 94, thereby producing no result or insuring the starting of the aforesaid disc, 94, if for any reason it failed with the outward swing of the pendulum just previously occurring. When the needle, 51, against reaches the other side of the ring, 123, the same accelerating cycle will again take place, thereby maintaining the pendulum system in vibration.

The rotation of the plane of oscillation of the system that is recorded in the sand, 122, may be measured at any time by comparing it with the graduations upon the top of the wooden ring, 119. It may possibly be found that the stroke of the suspension plunger, 57, cannot be adjusted quite close enough to insure a constant amplitude of the pendulum system. If this should be the case, although with the threaded shaft, 74, a fine adjustment can be obtained, the regulation should be so made that the amplitude will in time increase slightly, when by manually opening the switch, 154, for a short time the vibrations can be allowed to die down to the original amount. This function may be made automatic if desired. The reason for arranging the secondary circuit to be closed at the end of the pendulum's swing, instead of at its center, which may

be accomplished by providing a vertically adjustable metal disc for the needle, 51, to travel over when at the center of its motion, is because the suspension plunger, 57, would have to be normally resting at the lowest point of its stroke in order to properly accelerate the system. This would mean that the bob, 49, would be normally below the ring, 119, and would come in contact with the said ring, 119, either when about to start the pendulum oscillating or when in operation the action of the releasing magnet, 117, should fail for any reason. The contact in the center for this case would have to be comparatively large, for the pendulum bob, 49, would be traveling its fastest when passing over it.

The second method of controlling the releasing magnet, 117, of the suspension mechanism is shown in Fig. 3. This consists in substituting for the sand, 122, some electrically conductive sub-

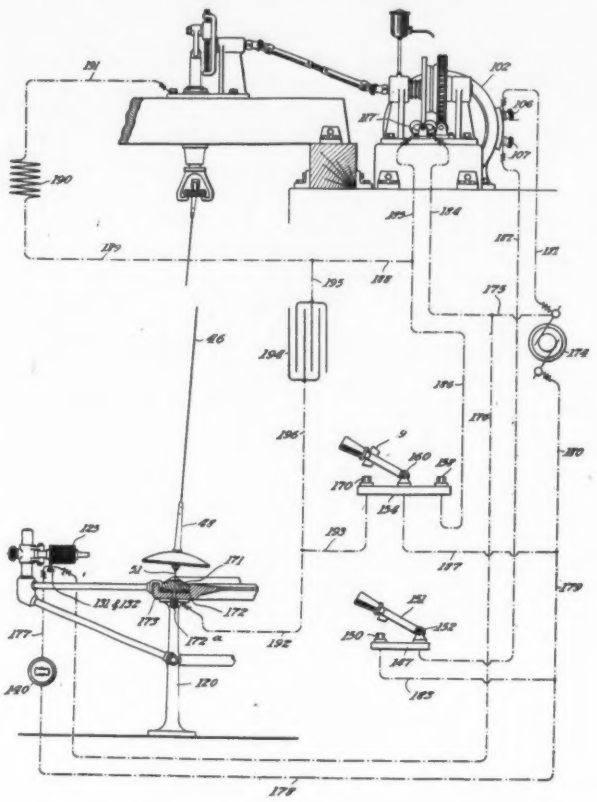


FIG. 3.—MODIFIED CONTACT AND WIRING FOR ELECTRICAL TYPE.

stance, 171, such as powdered graphite, copper or other metal filings. The substance, 171, rests upon a metal annulus, 172, which is placed in a wooden ring, 173. The ring, 173, is mounted upon the posts, 120, of the preceding design, and is graduated into angular degrees. A binding post, 172A, is fastened to the metal annulus, 172. When the pendulum needle, 51, passes through the conductive substance, 171, a furrow will not only be recorded, but an electric contact will be made, which is employed for controlling the releasing magnet, 117. The operation of the pendulum system is analagous to that already described. The wiring, however, is different. The circuit for the starting magnet, 125, consists from the source, 174, which in this case may be a direct-current generator if desired, of the wires, 175 and 176, post, 131, magnet, 125, post, 132, conductor, 177, switch, 140, together with the wires, 178, 179 and 180. For operating the suspension motor, 102, a circuit is provided which is made up from the source, 174, of a conductor, 181, post, 106, motor, 102, post, 107, wire, 182, journal post, 152, switch blade, 151, clip, 150, together with the conductors, 183, 179 and 180.

The circuit for manually accelerating the system embodies the source, 174, wires, 175 and 184, releasing magnet, 117, conductors, 185 and 186, clip, 158, switch blade, 159, journal post, 160, together with the wires, 187 and 180. The circuit for automatically controlling the pendulum consists from the source, 174, of the conductors, 175 and 184, releasing magnet, 117, wires, 185, 188 and 189, non-inductive resistance, 190, conductor, 191, suspension apparatus, pendulum wire, 46, post, 48, needle, 51, conductive substance, 171, metal annulus, 172, post, 172A, conductors, 192 and 193, clip, 170, switch blade, 159, journal post, 160, together with the wires, 187 and 180. For the elimination of sparking at the needle, 51, and conductive substance, 171, a condenser, 194, is shunted between the conductors, 189 and 192, by means of two wires, 195 and 196. If desired a relay may be employed in the controlling wiring. This would allow a potential of but several volts from a battery to be used at the needle, 51, and conductive substance, 171, the releasing magnet, 117, being operated directly from the source, 174. Such an arrangement would reduce the arcing to a minimum. Powdered graphite will give satisfactory electrical conductivity, and will probably offer less mechanical resistance to the passage of the needle, 51, through it than metal filings.

In Fig. 4 the third contact arrangement is illustrated for controlling the action of the releasing magnet, 117, of the suspension mechanism. Threaded into the lower end of the pendulum post, 48, is a screw-eye, 197, which has a light metal chain, 198, fastened thereto. The lower end of the chain, 198, is terminated by a platinum rod, 199. Mounted upon the iron posts, 120, of the railing, which is situated below the pendulum system, is a wooden ring, 200, having a groove formed therein for a mercury bath, 201. Resting in the groove in the ring, 200, is a metal annulus, 202, to which a binding post, 202A, is secured. The upper surface of the ring, 200, is provided with angular graduations, 203. The wiring for the pendulum system is the same as in Fig. 3, the contact for the circuit of the releasing magnet, 117, being made by the rod, 199, which dips into the mercury bath, 201, each time it passes the same. The angular change of the pendulum's plane may be noted when the rod, 199, is traveling over the graduations, 203. The chain, 198, and rod, 199, are both made light in order not to disturb the motion of the pendulum. The chain, 198, should also be short for preventing the rod, 199, from swinging unnecessarily.

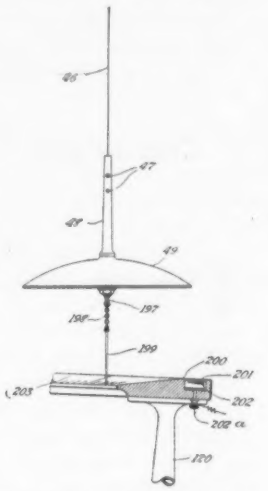


FIG. 4.—MODIFIED CONTACT FOR ELECTRICAL TYPE.

Other contact arrangements may be employed for periodically closing the circuit of the releasing magnet, 117. A flexible copper brush, for example, consisting of a small number of strands of fine wire, may be secured to the under side of the pendulum post, 48, and allowed to lightly pass over the surface of a metal ring when the pendulum is near the ends of its swing. The tilting of the pendulum bob as it swings from side to side may perhaps be made to actuate a mercury contact arrangement, incorporated in the interior of the aforesaid bob. Such a dispensation would embody a small twin concentric pendulum conductor, insulated knife-edge suspension and a bob so constructed that, when it is placed vertically, as would be the case when it is in the middle of its swing, a mercury bath inside of the bob will not short-circuit the two wires of the pendulum conductor. When, however, the bob is at one of the extremities of its amplitude, and is, therefore, in a tilting position, the mercury bath will short-circuit the two pendulum conductors, and thereby allow current to pass to the releasing magnet, 117, of the suspension driving mechanism. Various constructions and adjustments of the pendulum bob may be provided for this purpose. The principle of the coherer, in conjunction with the spark-gap arrangement already described, may possibly be taken advantage of for controlling the magnet, 117.

Let one of the above electrical designs be applied, for example, to a Foucault pendulum system having the dimensions of the original one in the Pantheon at Paris. There the length was approximately 220 ft., with a consequent period of 16.4 seconds or 8.2 seconds for each swing. The amplitude was 10 degrees and the diameter of the sand ring was a trifle over 26 ft. The pendulum bob weighed 61.72 pounds. If the beat of the pendulum is 8.2 seconds the time of one complete turn of the disc, 94, of the suspension driving mechanism would probably be about 7 seconds, or at the rate of 8.57 r.p.m. Inasmuch as the motor, 102, should have a surplus of power, let a ½-hp machine be chosen with a speed of 1,200 r.p.m. If the worm, 97, has a single thread the worm gear, 93, will then have 140 teeth in order to drive the disc, 94, at the desired rate. The worm gear reduction may be readily changed to suit the speed of any alternating or direct-current motor that it may be desired to run on the lighting system available at the

locality of mounting. The stroke of the suspension plunger, 57, will have to be experimentally determined, it being probably not over 6 in. for a 200-ft. pendulum. The most advantageous potential for the secondary winding in the step-up transformer, which is employed in the wiring system shown in Fig. 2, may preferably be settled by experiment, it depending upon the air-gap. For an arcing distance of one inch, the secondary voltage would be approximately 20,000 volts. Since, however, the air-gap can be made much less, the ratio of the windings in the transformer need not be so great.

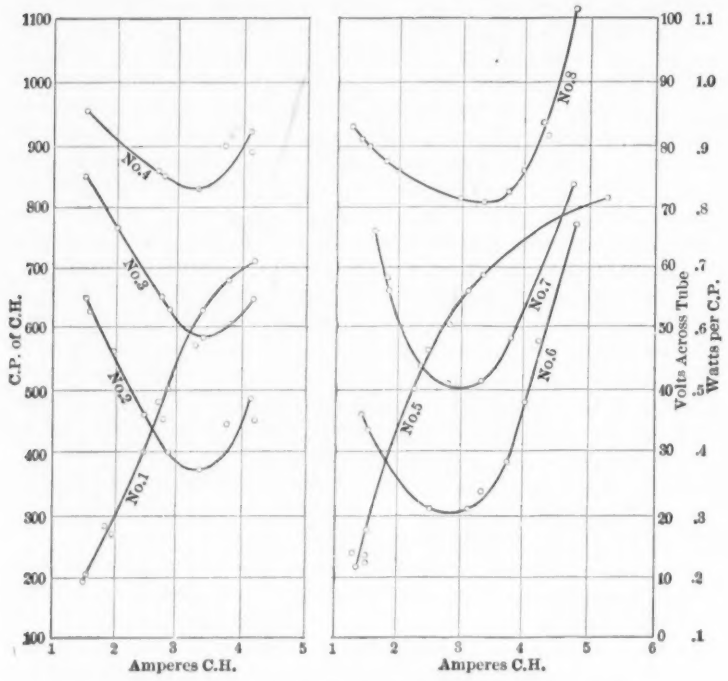
In the communication, mentioned at the beginning of the present paper, it has been suggested that a large Foucault pendulum system be installed at the Exposition in St. Louis. It is believed that such a feature would be an attractive one, and, besides being of physical interest, might form one of the chief exhibits of some college laboratory or physical instrument maker.

Candle-Power Tests of Cooper Hewitt Mercury Vapor Lamp.

By L. A. Freudenberger.

THE tests described below were made at Delaware College, Newark, Del., on a Cooper Hewitt mercury vapor lamp of the type known commercially as Type H-4. The lamp, which is rated at 3 amp. and designed for a 110-volt circuit, has a tube diameter of 1 1/16 in. and a length of arc of 45.67 in.

The lamp was mounted at one end of a five-meter photometer bar and enclosed in a long wooden box at right angles with the axis of the photometer bar. At the middle of the box, in line with the axis of the bar, was a 2 x 2-in. opening. The box was well ventilated so as to give conditions as near normal as possible. The illumination from a two-in. length at the middle of the Cooper Hewitt light was measured and the corresponding candle-power multiplied by the ratio 45.67/2, the length of the light-giving arc to the length of tube used. The lamp and box were inclined to the horizontal plane through the axis of the photometer bar by an angle of 11° 20′. The lamp was compared with a standardized 32-cp incandescent lamp. The screen used was a Lummer-Brodhun. The balance point



FIGS. 1 AND 2.—CANDLE-POWER TESTS OF VAPOR LAMP.

on the photometer bar could easily be located within one centimeter, although the two sides of the screen showed a great contrast in color. In the course of taking readings the screen was, of course, reversed, and the average reading taken.

In Fig. 1 curve 1 represents the variation of candle-power and current; curve 2, the variation of watts in lamp per candle-power; curve 3, the variation of total watts per candle-power with current; curve 4, the variation of current and volts across tube. In Fig. 2 curve 5 represents the variation of candle-power and current; curve 6, the variation of watts in lamp per candle-power and current; curve 7, the variation of total watts per candle-power and current, and curve 8, the variation of current and volts across the tube. In Fig. 3, curve 9 shows the variation of line voltage and current, and curves 10 and 11 the relation of minimum watts per candle-power and current. The curves of Fig. 2 were taken when the lamp was new. The curves of Fig. 1 were taken after the lamp had been running about twenty-four hours.

The reduction in candle-power noted is due to a coating, at first gray and afterward black, which gradually forms all over the inside of the tube. No life tests of the lamps were made, but of two lamps which have been run continuously, one burned out after 800 hours

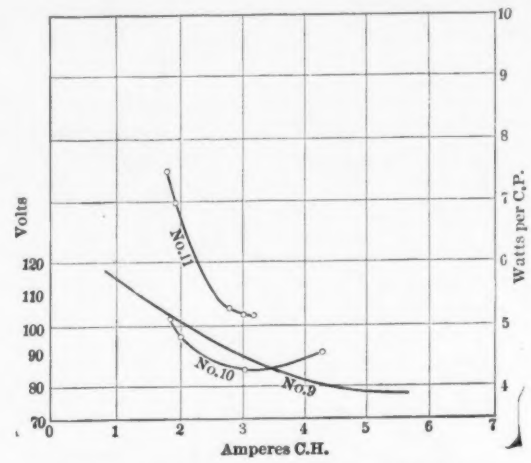


FIG. 3.—CANDLE-POWER TESTS OF VAPOR LAMP.

and the other had not burned out after running 1,000 hours. The lamp that burned out blackened somewhat similar to an incandescent lamp. The immediate failure was due to the impairment of the vacuum, principally through leakage at the leading-in wires.

For all curves the currents were read after the lamp had settled to steady temperature conditions, and the values used as abscissæ. All instruments were calibrated by means of standard cells and standard resistances.

Curve 6 on Fig. 2 was obtained by multiplying volts across the tube by current and dividing by the candle-power corresponding to the current. It represents the watts per candle-power consumed by the lamp itself. Curve No. 7 was obtained by multiplying line volts (assumed constant at 110 volts) by current and dividing by corresponding candle-power. The efficiency in watts per candle-power includes the loss in the ballast resistance in series with the lamp. The curves on Fig. 1 are precisely similar to the curves on Fig. 2, except that they were taken after the lamp had been running about twenty-four hours.

Curve 9 of Fig. 3 merits some explanation. A value of ballast resistance was chosen and the line voltage lowered slowly until the lamp went out. The line voltage and current were taken at the point where the lamp went out and plotted on curve 9. Curves 10 and 11 were obtained by calculating watts per candle-power, using the voltage given by curve 9. Curve 9 shows the minimum line voltage at which it is possible to run the lamp with a certain current. The difference in ordinates between curves 8 or 4 and curve 9 would give the drop in the ballast resistance under this condition.

The above tests were submitted as a thesis in electrical engineering by Mr. F. Schabinger. Thanks are due to the Cooper Hewitt Electric Company for furnishing the lamp, and also to Mr. H. Spoehrer, of the Brooklyn Navy Yard, for furnishing a standardized 32-cp lamp.

Michigan Electric Light Association.

Managers of a number of electric lighting plants in Michigan met in Detroit on June 9 and formed the Michigan Association of Electric Light Managers. Mr. E. F. Phillips, assistant manager of the Edison Illuminating Company, of Detroit, was elected president, and E. S. Hubbell, of Milford, was chosen as secretary. Several committees were appointed to take charge of the work of perfecting plans for future action. The meeting was only preliminary and the association will not get down to business until these committees have reported.

Lost and Unaccounted-for Current.

In our report of the Boston meeting of the National Electric Light Association we referred particularly to the paper by Mr. C. W. Humphrey with the above title, and owing to its exceptional interest it is reprinted below in full, excepting a few of the sheets of tabulations.

The object of the paper was stated to explain in full the calculations of losses, known and unknown, for alternating and direct-current circuits, and to give the records of some of the results obtained and tabulated during the past two years. Most of the data given was compiled from results obtained on the lines of the Denver Gas & Electric Company.

The lines in Denver are now all 2,400-volt, single-phase feeders, but the calculations are approximately the same for all systems of distribution, regardless of voltage, frequency or phase. Even in high-tension transmission lines the same methods may be used, there being no actual losses introduced by inductive drops. Most high-tension lines, however, have integrating wattmeters on both ends of the line. The difference in the readings will indicate the total loss in transmission. This loss may be easily subdivided into resistance losses and transformer losses.

Direct-current losses may be calculated in much the same manner as those of alternating-current circuits, although resistance losses and meter shunt losses are all that must be accounted for. The "drop of potential" method was found the most satisfactory for calculating the line losses, following along the same lines as described for alternating-current circuits (mentioned later). The meter shunt losses were taken care of in the same way as for alternating currents.

The different losses in an alternating-current system may be classified as follows: Transformer iron losses; primary resistance losses; secondary resistance losses; meter shunt losses. For the transformer iron losses there is a card index system consisting of two sets of cards. One set has a card for each transformer on the lines and also those in stock, and shows the date of purchase, where set, manufacturer's number and type, iron and copper losses as shown by test, and also whether or not the transformer has been removed and for what cause, as well as a retest on its iron loss before it is again placed in service. In fact, these cards show the entire history of each transformer from the date of purchase up to the present time. The other set of cards, which is called the feeder index, shows the exact location, make and number of transformer, also the number of feeder on which it is located. These cards are arranged according to location and feeder, while the other index is arranged numerically according to the make and number of the transformer. The records are not as complete as the above statement might seem to imply, due to the fact that these records have all been started within the past two years and do not include full data on transformers purchased prior to that time.

In a great many instances transformer iron losses were tested while in service. This was done in a very unique way and without interruption to service. There is a small testing board, which includes a wattmeter, voltmeter and a small variable resistance. To these instruments are attached two flexible duplex cables of sufficient length to reach from the ground to any transformer on any pole. The primary fuses of the transformer are pulled, the neutral of the secondary is disconnected (that is, if the transformer is on a three-wire network), one side of the secondary is left intact and the other side is cut, and the wattmeter and resistance are inserted in the circuit by means of one of the flexible cables, the other cable being used for pressure wires. The secondaries are kept alive by the other transformers on the system. The resistance is then so adjusted that normal voltage is impressed across the secondaries of the transformer. Readings are then taken on the wattmeter, which indicates approximately the iron loss and may be corrected for instrument losses in the usual way.

There is also kept a transformer record sheet for the purpose of more readily finding the transformer iron losses as soon as possible after the first of the month. These sheets have a line for each day of the month, on which is placed the number of transformers of each size and make according to the different headings. On the extreme right of the sheet is a column for the total transformer iron loss for one day. This represents the total 24-hour loss on that particular feeder, which is the summation of all the individual losses pertaining to the transformers on each line. At the end of the month this last column is totalized, and this represents the total loss for the month on that feeder.

The next known loss to consider is the primary resistance loss. This loss has been more difficult to ascertain correctly and keep up from month to month than any of the other known losses. Four different methods of calculating this loss have been used and each different method and endeavor will be discussed to show the advantages and disadvantages of each.

The first method used was to measure up the length and size of wire in the primary feed, assuming one ampere to be flowing from the station to the first division point in the feeder, then assuming the current to divide proportionally to the connected load in each branch of the feeder; calculating and summing up all losses due to an initial flow of one ampere and using that as a constant. Then ampere-meter readings are taken at short intervals at the station during a period of 24 hours. Each of these readings is then squared and multiplied by the constant. The summation of these losses will give the total primary resistance loss for one day. This method is fairly accurate, but is long and tedious and cannot be relied upon any better than other more simple methods. One point of error in this method is the fact that a suspended wire stretches in course of time, making its cross-section smaller than it was originally and therefore of higher resistance. Joints and junction fuses also introduce errors of more or less magnitude. The results as obtained from this system are always considerably smaller than actual measured results.

The author undertook to accomplish the desired result by placing recording voltmeters at the station and at the center of distribution and then taking the difference between the two readings and multiplying by the load in amperes corresponding to the drop in voltage, and summing up as in the previous method. This would be a very satisfactory method if this drop could be ascertained correctly. A small potential transformer is usually employed for the purpose of stepping the voltage down for the recording voltmeter. The ratio of these transformers, when used on a 2,400-volt feeder, would be 20 to 1. These voltmeters cannot be read with an accuracy closer than one volt; therefore, it means an error which must be multiplied by a constant of 20, and when two voltmeters are used, one at the station and one at the center of distribution, it makes a possible multiplication of an error by a constant of 40. This error amounts to considerable where accuracy is essential.

The next method used was to place an integrating wattmeter in the primary lead just before it begins to feed, running pressure wires for it back to the center of distribution. Readings were taken the first and last of the month, and kilowatt-hour readings obtained subtracted from that obtained on the station wattmeter for the same period. This is a very good method, provided there are no grounds or individual taps taken off between the two wattmeters. If this should be the case, the results obtained might lead to an erroneous impression.

The method finally adopted and now used exclusively is a measured resistance method. With the use of this method the feeder must be shut down at some convenient time, preferably during light load, and the primary fuses of all transformers pulled; that is, all those on the station side of the center of distribution. The primaries are then short-circuited at this point and the resistance of the circuit is measured by the "drop of potential" method with direct current, the direct current being supplied from a separate direct-current machine and the voltage varied so as to permit of a series of readings being taken. The loss is then calculated by means of ampere readings taken at the station at stated intervals, the same as in the first two methods. Or a better way than calculating each particular point is to calculate the losses for different amounts of current and plot a curve of watt loss and primary amperes. This curve also includes the primary copper loss of the transformer on the feeder, full load on the feeder being considered as the sum of the full-load capacities of the different transformers. The readings taken at the station may then be readily run off on this curve and summed up for a period of 24 hours, full-load copper loss of the transformers for the entire feeder being the sum of the individual losses for all transformers on the feeder. The copper losses of a transformer are assumed to be divided equally between the primary and secondary windings. This assumption has been borne out by tests. Fig. 1 is a curve showing the different primary losses as calculated above.

After losses are obtained for a period of one day, the total loss for the month must be calculated. This is done by multiplying the

output on the feeder for one day by the number of days in the month and dividing into the total output for the month as obtained on the feeder wattmeter. This result is squared and multiplied by the loss for one day and multiplied by the number of days in the month. These results will be as close as it is possible to calculate them

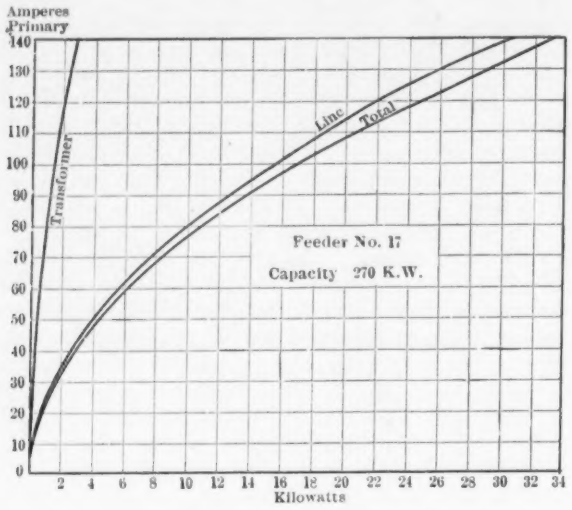


FIG. 1.—CURVE OF PRIMARY LOSSES.

and would be very accurate if it were not for the fact that the characteristics of the daily load curve change during the different seasons of the year. The peak is very sharp in the summer with a very small morning peak, while in the winter the peak is quite broad and the morning peak is much more noticeable. For this reason these losses must be recalculated from time to time during the year as these characteristics change. Fig. 2 shows a curve of one of the principal

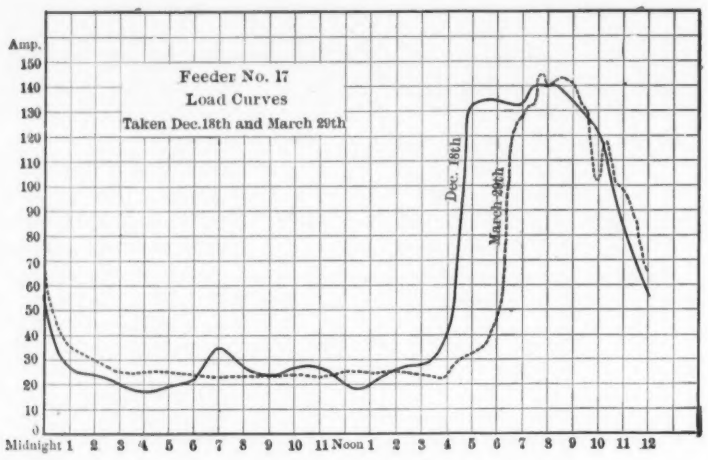


FIG. 2.—LOAD CURVES.

business feeders illustrating these different characteristics. The greater demand shown for March 29 is due to new business on that feeder. Evidence of new business is shown throughout the curve. Both December 18 and March 29 were clear days.

The kilowatt-hours lost due to primary resistance for one year, multiplied by the actual cost of generation, will show whether reinforcements would pay financially and to what extent they might be carried. By cost of generation is means the variable costs, which vary as the output; it does not include any of the fixed expenses.

The secondary resistance losses are somewhat more difficult of accurate calculations. Following is the method which was used exclusively for the three-wire secondary network.

In this calculation some things had to be assumed in order to arrive at results. The total secondary load is assumed to be divided up in proportion to the sizes of the different transformers, one-half the load on each transformer to feed each way, and this amount of current to feed one-fourth the distance between transformers. The assumptions have, however, been verified in each case by the testing of all transformers on the line. This assumption would not hold true, however, before the company began to test the transformers systematically and place them on the lines in accordance with the actual load carried, instead of depending, as is usual, upon the connected load. It was found that the actual load carried varied very widely from that calculated on a basis of connected load.

With these assumptions and the size and length of secondary feeds being known, the losses may be figured for several different amounts of current flowing, and plotted in a curve. The author also figured the loss due to current flowing in the neutral, but this loss was found to be negligible on his system of distribution, due to the fact that the transformers are so evenly balanced that there is a minimum flow of current in the neutral. This is not the case on the majority of distributing systems, as most of the transformers are in the same condition as his were before a systematic test was instituted by means of an instrument termed the "portable line meter." The instrument consists of an ammeter directly calibrated with a small series transformer having a two-piece iron core hinged together so as to permit of its being opened and clasped over a wire at any point. With this instrument he has been enabled to measure the exact load carried on a transformer at any time, also the amount of unbalancing. The loss in the neutral does not vary as the per cent. of unbalancing and is, therefore, inappreciable for small amounts of unbalancing. But in most systems of distribution, where this unbalancing is quite considerable, it becomes an important item. Unbalancing not only increases the losses materially, but also decreases the available capacity of the transformer quite materially. It has been claimed that transformers banked together on a three-wire network would adjust themselves to the total unbalancing of the feeder. This is not true, as the author found transformers of the same make and size on adjoining poles considerably unbalanced on opposite sides; and even in cases where transformers are banked together on the same pole, they will not divide their loads evenly. This was very strikingly illustrated by an occurrence that took place some time ago. During a breakdown in an isolated plant furnishing power for a theatre, the author was called upon to furnish them with light. In order to do this he placed six 10-kw transformers

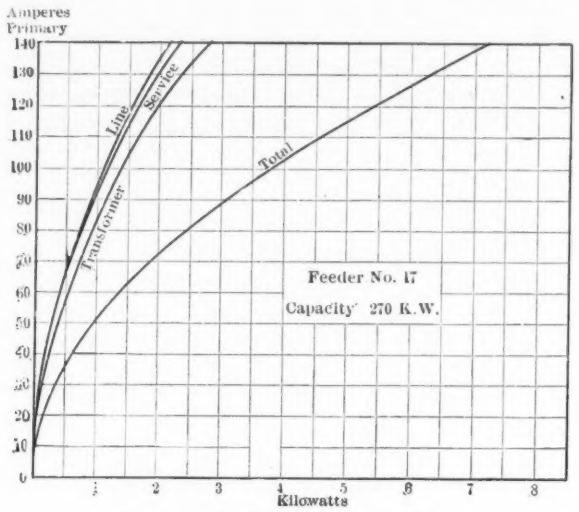


FIG. 3.—CURVES OF TOTAL LOSSES.

and one 20-kw transformer, all of the same make and type, just outside of the building and connected them up for 110 volts, lying them together with a 500,000-cm. cable, which fed the theatre. Following is the average load in amperes on each transformer during operation:

Size.	Load in Amperes at 108 Volts.
10-kw	106 amperes
10-kw	93 amperes
10-kw	130 amperes
10-kw	112 amperes
10-kw	90 amperes
10-kw	90 amperes
20-kw	158 amperes

The author also took into consideration the resistance losses in the service loops. This is taken care of by assuming the secondary load to be equally divided between the different service loops, and taking the average length and size of a service.

The secondary transformer copper loss is taken into consideration in the same way as in the primary losses. A curve is then plotted of the secondary resistance loss, secondary transformer loss and service resistance loss, and then a curve of the total losses is plotted. A sample of one of these curves (Fig. 3) is here shown, watts loss being plotted against primary amperes.

The all-day losses are obtained in the same way as with the

primary, using the station ampere readings in the same way; the station ammeter not being relied upon entirely, a standard portable instrument being cut in and used, and the switchboard meters being calibrated at the same time.

The only known loss now left to determine is the meter shunt loss, a loss that one might think at first hardly worth considering, but which is nevertheless of considerable importance and assumes very large proportions in some instances. The loss can be obtained with a greater accuracy and less trouble than any other of the losses. Each different type and size of meter must be tested and the average of a number of different tests taken. The author uses a meter record sheet for the meter losses on each feeder similar to the transformer record sheets. These sheets are kept up from day to day, and at the end of the month the daily losses are summed up, giving the monthly losses. It was found to be much easier to keep up the records in this way from day to day on the different feeders than to wait until the end of the month and then figure up the losses for the past month. It is also the most accurate, and the total losses may be ascertained much more quickly after the first of the month.

The total sales are figured up at the end of each month, and as meters are read in three different divisions at different times, the results do not exactly correspond to the monthly output. The bills for one-third of our consumers cover a period from the first of one month to the first of the next month, one-third from the 10th to the 10th, and one-third from the 20th to the 20th. This variation might amount to considerable in one month, but, as everything is figured accumulative from month to month, the records are very accurate when figured over a space of several months.

After this full explanation of the methods for arriving at the known losses, it will be interesting to note the results obtained in some of the feeders for the past year. There are 24 different feeders, on all of which the above records are kept up from month to month. The author has plotted graphically the losses on some feeders, showing variation of losses from month to month and the gradual but steady decrease in the unknown losses. The first curve (Fig. 4) is

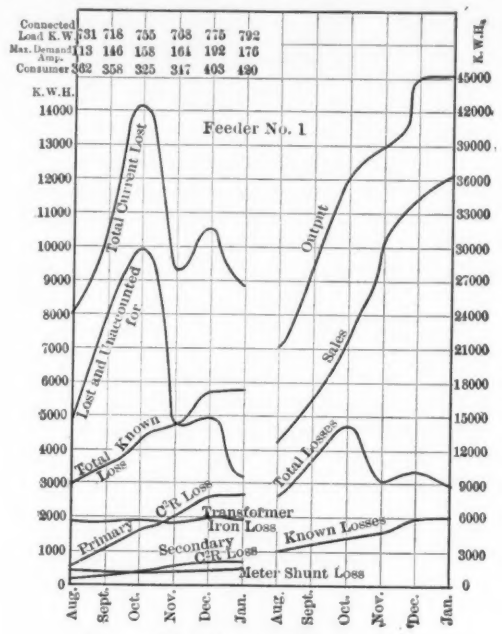


FIG. 4.—CURVES OF FEEDER LOSSES.

that of a residence feeder, which is designated as 1 West. It will be noticed that the output and sales have increased very rapidly. A slight hump will be noticed in the output during October; this is due to some unknown loss, as the curve of sales does not show this characteristic, neither does the curve of known losses. It will be noticed that both the primary and secondary losses show a steady increase due to the increase in the output. The transformer iron loss remains about the same and so do the meter shunt losses. The relation that the sales show to the output varies from 59.3 per cent. to 80.5 per cent., being almost a steady increase from beginning to end, the unknown loss increasing at about the same rate as the output for the first two months, dropping off the next month, and then remaining about the same for the remainder of the period, although both the sales and output increased considerably.

In the accompanying table is a tabulation of an alternating-current feeder for a period of six months. During that time the feeder was changed from a 1,000-volt individual transformer system to a 2,000-volt with a three-wire secondary network, with the exception that there are still some instances where individual transformers are used, due to the sparsely settled territory it covers.

This tabulation shows several very interesting things. During the first two months the individual transformers were done away with

TABLE SHOWING ECONOMY OF THREE-WIRE OVER INDIVIDUAL TRANSFORMER SYSTEM.

Month.	Output.	Sales.	% of output.	Lost and unaccounted for.	% of output.	Transformer iron loss.	% of output.	Primary C A loss.	% of output.	Secondary C A loss.	% of output.	Meter shunt loss.	% of output.	Consumers.
1	19250	7778	40.4	4877	25.4	5940	30.9	222	1.1	138	.7	295	1.6	273
2	15970	6630	41.5	2235	14.1	6475	40.5	229	1.4	92	.6	309	1.9	277
3	20042	10506	52.5	6140	30.6	2560	12.8	373	1.8	150	.7	313	1.6	281
4	35320	21166	60	9417	26.6	2390	6.7	1153	3.3	463	1.3	721	2.1	660
5	40140	28480	71.2	6421	16.1	2441	6.1	1440	3.5	580	1.3	770	1.0	692
6	40940	29113	71.2	6435	15.7	2425	5.9	1503	3.6	605	1.5	859	2.1	771

and replaced with a three-wire network showing a reduction in transformer iron losses from 6,475 kw-hours to 2,560 kw-hours, a decrease of a little over 60 per cent. At the same time the lost and unaccounted-for has taken a jump of nearly 170 per cent. The output and sales increased considerably the same month, due to combining another feeder with this one, adding 387 consumers, which were changed over at the same time to a three-wire distribution. In this instance the sales were increased to nearly double the original amount and the transformer iron loss was decreased to about one-half the original amount. The primary and secondary resistance losses were increased considerably, due to the increase in the output of the feeder.

A complete record sheet is kept for all the rest of the feeders. One of the interesting things on this feeder is that the watts per lamp of output remained about the same for the entire year, while the watts per lamp of sales increased during the same period to nearly double. The sales increased from 41.6 per cent. to 83.5 per cent., the known losses remained about the same, while the unknown losses decreased from 48.4 per cent. of output to only 5.22 per cent.

The lost and unaccounted-for current has been systematically followed up and decreased very materially. This unknown loss is due to leakage through grounds, faulty meter registration, errors and theft. These losses have been plotted graphically as shown in Figs. 5 and 6. Each circuit is tested for grounds, and when found these are traced down and removed.

The greater part of the lost and unaccounted-for current was

FIG. 5.—CURVES OF CURRENT LOSSES.

found to be due to thefts. These were found by systematic inspection of service loops and interior wiring. Theft of current was found to be done usually by tampering with the wiring, remov-

ing pressure wires and jumping out meters, installing lamps ahead of the meter, and in some instances tampering with the meter so as to retard its rotation. Some of these things are very difficult to find, especially in cases of concealed wiring. Some cases of slow meters were found by placing a check meter on the secondary of a transformer feeding a three-wire district, making an isolated district of it by opening up the junction fuses on each side of the transformer. There are quite a number of ampere-hour meters on the circuits, which accounts for some of the lost and unaccounted-for,

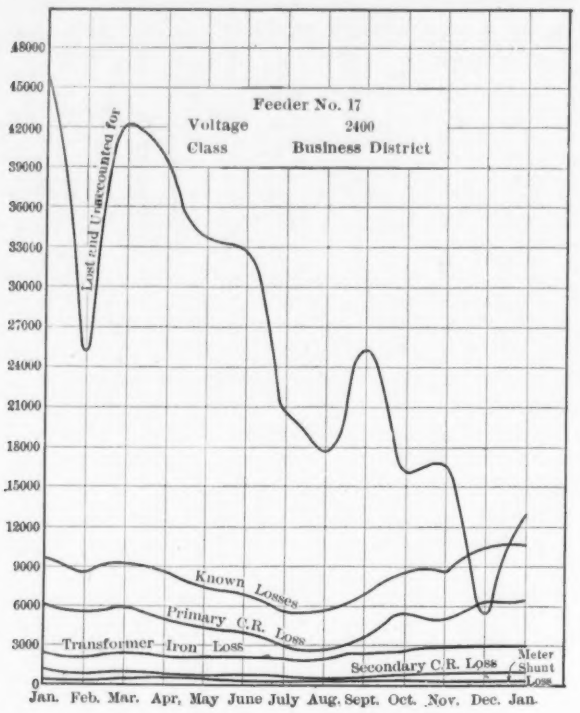


FIG. 6.—CURVES OF CURRENT LOSSES.

as an ampere-hour meter will not start on less than two to four 16-cp lamps. A check meter was placed on one district having nine ampere-hour meters and eleven integrating wattmeters. The results were as follows:

Registered on house meters	331.5	kw-hours
Shunt loss on 11 meters	6.14	kw-hours
Total	337.64	kw-hours
Consump. as shown by check meter	367.3	kw-hours
Loss	29.75	kw-hours, or 8.1 per cent.

About the only absolute method of preventing theft of current, and as yet only adopted in isolated instances, is to place all meters on the pole. This could be accomplished in the business districts of the city by placing a number of meters in one box on a pole and running all services from this box and, where possible, bunching the wires in one cable. This would be especially advantageous where feeding a large number of consumers in a large business block, and where the running of such a cable would not be more objectionable than the present practice of bussing such a building. The principal advantage of such a system would be the impossibility of stealing current from the light company. It should be getting paid for all current distributed and the losses would certainly be materially and permanently decreased.

This completes the discussion of all the principal items relative to the calculations of lost and unaccounted-for current. The importance of an analysis of the output of an electric station can be readily seen by the results given in this paper, and in the majority of instances such an analysis will show such startling results as will lead to investigations that will pay for the time and trouble many times over. In no other way about a central station can money be spent more profitably.

Recent Electrochemical Developments.

Four patents, granted on June 14, refer to battery invention. J. E. Haschke describes mechanical details of construction of a multiple-cell high-voltage battery of that general type in which the cells are put one upon the other like a series of dishes, the walls of the different cells serving as bipolar active plates.

M. Schneider patents mechanical details of a battery in which the positive pole electrode is formed of a number of downwardly converging ribbed lead cones, put one above the other and fastened in the center to a lead core, while the negative pole electrode is formed of a hollow metal cylinder encompassing the positive electrode.

A. J. B. M. Colletas patents a battery in which the active material of the negative pole is a layer of copper hydride (Cu_2H_2) on a copper plate, while the positive electrode is lead peroxide, with sulphuric acid as electrolyte. The electrochemical action during the discharge is the formation of copper sulphate and water and reduction of the lead peroxide to lead oxide.

J. R. Lord patents a general type of battery of which the following combinations may serve as example: The anode is a mixture of zinc and zinc oxide, the electrolyte a gaseous solution of potassium sulphate, and the cathode is copper with the addition of a depolarizer, PbO_2. The theoretical explanations of the inventor are somewhat peculiar.

New Telephone Patents.

A NOVEL RELAY.

Considering the fact that the contact relay has been developed to a point where certain forms have become almost standard, the appearance of an entirely new type may be noted as quite remarkable. Nevertheless, such a new type has appeared, being described in a patent issued to F. R. McBerty, of Evanston, Ill., and assigned by him to the Western Electric Company. This relay is designed for use in strips, the mounting strip, in fact, forming a common return pole piece for the group of relays mounted thereon. Reference may be made to Fig. 1, which shows well the appearance and con-

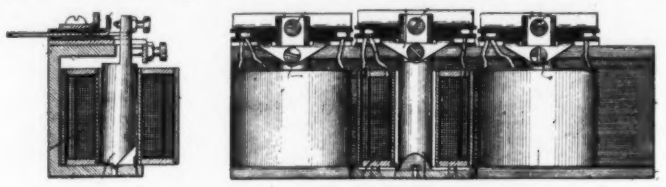


FIG. 1.—M'BERTY RELAY.

struction of the relay. As will be noted, the core of the relay is free to oscillate within the coil spool, being supported upon its chisel-edged lower end. The contact circuit is carried through the body of the core, the contact anvil being clamped between insulating strips upon the top of the mounting strip. To avoid "cross-talk" between adjacent coils, these are encased in copper shells. The chief objection, at once apparent, lies in the necessity of removing a whole strip of relays in order to replace the parts of any one in case these relays be mounted in groups according to the present custom.

ELECTROMAGNETIC SIGNALS.

It is quite frequently desirable in telephony that a single signal give two different indications under substantially the same circuit conditions. Under such circumstances it has been necessary to provide auxiliary apparatus and circuits to control the signal proper.

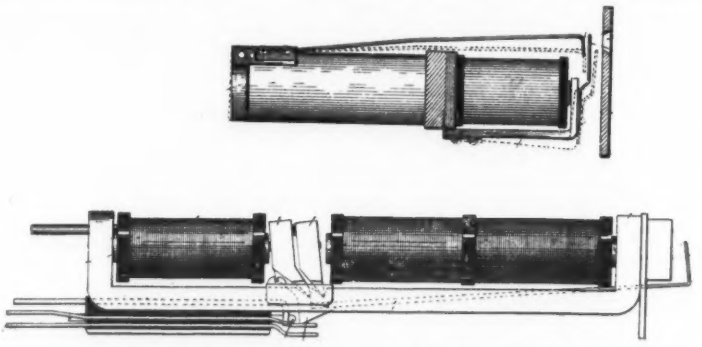


FIG. 2.—M'BERTY AND M'QUARRIE ELECTROMAGNETIC SIGNAL.

There have now appeared patents for several signals in which the secondary controlling device is combined with the signal to form a single piece of apparatus. In two cases the auxiliary device includes a movable shield for signal target, the target being displayed only when it and its movable shield bear the proper relation to a stationary shield. The means employed for controlling the movable shield differ. Both signals described are for use as line signals.

Of these one is shown in the upper part of Fig. 2. As indicated by the dotted lines, when neither coil is energized neither movable part shows. When the rear coil, that connected in the line circuit, is energized, in response to the rising of the hook switch of the subscriber, the target is displayed; and when the operator answers the front coil, in series with one of the jack circuits, becomes energized and elevates the movable shield to obscure the target. This signal is the joint invention of Messrs. F. R. McBerty and J. S. McQuarrie.

In the second line signal the signal and its corresponding jack are mounted together, so that the movable shield may be mechanically elevated by the insertion of a plug. This is the work of the same inventors.

The second type of signal uses another means as an auxiliary control, viz., an auxiliary locking armature. Such a signal is shown in the lower part of Fig. 2. The left-hand armature carries the target. The right-hand armature is the locking one, the weights of the parts being so proportioned that the two armatures acting together will overbalance the target, while the target will overbalance its own armature alone. The target shield is so arranged that the target will be displayed at the window when released by the locking armature. The normal actuating coil is, therefore, that controlling the locking armature. This coil is double-wound for line signals and single-wound for supervisory signals. The left-hand coil is connected with the third wire or local signal circuit to be energized only when a plug is inserted in a jack. The operation is then as follows: When the right-hand or actuating coil is energized the locking armature is pulled up and releases the target to fall before the window. When the operator answers, the restoring coil raises the target into the concealed position. Two patents cover this signal in its various uses, the one granted to F. R. McBerty and F. H. Loveridge and the other to J. S. McQuarrie. The Western Electric Company has obtained all of the above-mentioned patents by assignment.

A NEW LOADING COIL.

Dr. M. I. Pupin has patented a new type of loading coil for use, as the name signifies, in inductively "loading" cable or other conductors to reduce the attenuation of transmitted waves. The coil has a closed magnet circuit, the core being completely covered with windings threading through the aperture. In the specification the requirements for satisfactory loading coils and the limiting values of hysteresis and Foucault current losses in the iron are set forth and formulæ are given for the design of satisfactory coils. The matter is of too technical a nature to warrant detailed consideration here, but those interested will find much of value in the patent. Dr. Pupin has assigned his patent to the American Telephone & Telegraph Company.

LAMP JACK STRIP.

A new lamp jack strip forms the subject of a patent granted to H. P. Clausen, of Chicago. Mr. Clausen builds up his jacks upon a sheet metal strip, no partitions being provided between the lamps. On this account the lamps, except at the extreme end, are each encased in a sleeve of opaque material to prevent any confusion of signals. The opals are mounted permanently in the face of the strip, which face is removable as a whole. It is the inventor's idea to obtain a cheap yet serviceable construction. The patent for this socket strip has been obtained by the American Electric Telephone Company, of Chicago.

STEP-BY-STEP PARTY LINE SYSTEM.

A step-by-step party line system has been invented by E. W. E. Tomson. The system is adapted to permit of a central office selecting at will any station on a line to the exclusion of others. It depends for its operation upon the synchronous action of the instruments at all stations in response to properly timed current impulses sent out by the operator.

FIRE ALARM SYSTEM.

W. L. Denio, of Rochester, N. Y., has made and patented further improvements in his fire alarm system for use in connection with telephone lines. The present devices may be operated manually or by thermostats, to send to the telephone central office a vibratory flash signal appearing at the line lamp. This signal is repeated a number of times to indicate the location of the fire upon the subscriber's premises, the various thermostats being connected in groups to a signal box. A further feature is the automatic clearing of the telephone line for conversation as soon as the fire signal has been sent in.

TELEPHONE RECEIVER.

The last patent for present consideration is one granted to Ernst Gundlach, of Berwyn, Ill., for a telephone receiver and assigned to the American Telephone & Telegraph Company. This receiver is built upon the same general lines as one patented by the same inventor some six months since, and has for its most novel features a spring device for mechanically straining the diaphragm in a direction opposed to the magnetic pull, and the provision of a pole piece mounted at the center of the diaphragm. The core of soft iron but partially fills the spool aperture, the armature extending loosely within the upper portion of it. Great sensitiveness is claimed for this type of receiver.

Municipal Ownership at Ottawa, Can.

A correspondent at Ottawa, Canada, writes us as follows: "In an item taken from the *Canadian News* in your issue of June 4 the following appears: 'The city of Ottawa, some two years ago, voted for a civic lighting system, but at a recent meeting of the city council, in spite of the voice of the citizens, the Ottawa Electric Company was given a contract for street lighting for a period of ten years at $52 per light. Although this is a very favorable contract and a reduction of some $13 per lamp, yet there is much indignation manifested by the ratepayers that their wishes have been disregarded. The report of experts showed that the city could do its own lighting for $38 per lamp per year. Ottawa, therefore, stands to lose $80,000 over the ten years which the contract is to run.' It is quite evident that your correspondent is not only a partisan of municipal ownership, but also in sympathy with the Mayor and the few Aldermen who have been favoring the erection by the city of a distributing station for street lighting; electric power, therefore, to be purchased. The Ottawa Electric Company tendered for city lighting by direct-current enclosed lamps of 480 watts for ten years, at $52 per lamp, all night and every night. This is the cheapest rate in Canada, and it was accepted by the city council, a large majority of whom evidently believed that the city could not do better. Your correspondent would make it appear that this action on the part of the council had aroused public indignation; as a matter of fact, interested Aldermen did cause to be called an indignation meeting to protest against the action of the other Aldermen who did not share their opinions, but this meeting proved a veritable boomerang, ending up by the passing of a resolution by a vote of two to one, approving the action of the majority of the council in giving the contract to this company.

"An expert engineer employed by the city made an estimate of $38 per lamp per year, but other well-known experts employed by other parties showed that the city could not do its own street lighting on the plan proposed for less than $52 per lamp, so that the report that the city stands to lose $80,000 in the ten years is mere conjecture. The item is one of the kind that are dished out regularly by the municipal ownership partisan press, but it is quite misleading."

National Electric Light Association Membership.

At the twenty-seventh convention of the National Electric Light Association, held in Boston, May 24-27, an amendment to the constitution was adopted dividing the membership into six classes, as follows: Class A, Member Companies—Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. Entrance fee, $25; annual dues for companies in towns of less than 20,000 population, $10; 20,000 to 300,000, $25; over 300,000, $50. Class B Members—Officers or employees of member companies, elected and continued from year to year with the written consent of the member company with whom connected. Entrance fee, $5; annual dues, $5. Class C, Instructors and Teachers of Engineering and Related Sciences—No entrance fee, annual dues, $4. Class D, Associate Member Companies—Electricians, electrical or mechanical engineers, manufacturers, corporations or individuals, who are directly or indirectly interested in advancing the interests of electricity. Entrance fee, $25; annual dues, $2. Class E—Officers and employees of Class D, elected and continued by written consent of the Class D member employer. Entrance fee, $5; dues, $5.

There will also be a class of honorary members without fees or dues.

CURRENT NEWS AND NOTES.

CHEAPER RADIUM.—Dr. George F. Lee, of Philadelphia, declares that he has discovered an electrochemical process of manufacturing radium for less than $500,000 a pound. Dr. Lee says he learned from the Curies that barium and thorium rock particles clung to radium. He set to work to thoroughly analyze these rocks and abstract their luminous properties. He placed the combination of barium and thorium in a box and found, after a time, that they produced a fluorescent substance that would penetrate metal. He states that it will be only a short time before he will be able to produce radium. It is not very clear that Dr. Lee has anything in particular.

ELECTRIC POWER IN SCOTLAND.—Mr. Rufus Fleming, United States Consul at Edinburgh, Scotland, says: "No trade here has a better prospect at this time than that of the electrical engineering firms. The demand for motors and all other electrical apparatus will undoubtedly continue to grow from month to month, and American companies prepared to compete in these lines of manufacture have now their best opportunity. The application of electricity as a motive power in various industries, for urban lighting and traction, as light and power for coal mines and other uses, examples of which are numerous, mark the real dawn of the electric power era in this part of Great Britain. American manufacturers have in the past few years furnished some of the heavy machinery for municipal generating stations and private plants, and also a considerable number of dynamos, motors, etc. American-English concerns have done much in this line—in fact, they seem to be well ahead of all others. Recent developments mean an expanding market, to which our manufacturers of electrical machinery and supplies may find it profitable to devote earnest attention."

LETTER TO THE EDITORS.

The Government and the Fessenden Wireless System.

To the Editors of Electrical World and Engineer:

SIRS:—Will you kindly permit me to make the following corrections to the statements reprinted in your issue of June 22 from the New York *Evening Post,* under the title, "A Government Wireless Mix-up," as some of the statements contained therein would do us considerable injustice unless promptly corrected.

1. The Agricultural Department is not in any tangle with Prof. Fessenden, but on the contrary relations between the Department and Prof. Fessenden are entirely harmonious.

2. The statement that the Agricultural Department now claims, or has ever claimed in the past, to own the system of Prof. Fessenden, is a falsehood manufactured out of the whole cloth. No such claim has ever been made by the Department or any of its officials.

The facts in the case are that after Prof. Fessenden had been developing his system for a year or more in Pittsburg, the attention of the Agricultural Department was attracted by some of the experiments which he had made in operating across the cities of Pittsburg and Allegheny. A contract was, therefore, entered into according to which the Department, in return for the expenditure of some $15,000, obtained the right to use all of Prof. Fessenden's inventions which were invented up to July, 1902, "For its use in receiving meteorological reports and transmitting Weather Bureau information." Subsequently to July, 1902, the development of the system was carried on by Prof. Fessenden at a further cost of over $200,000.

While, therefore, the Weather Bureau has made an extremely advantageous bargain for the Government in securing at cost of manufacture apparatus which would otherwise cost it some $500,000 or $600,000, the Department does not and never has claimed to have any right whatever to the Fessenden system, or any right to use the same for anything except the specific "Transmitting of meteorological reports and Weather Bureau information." According to the contract, "All commercial rights and privileges in connection with this invention are reserved by said Fessenden."

3. This system was not invented by Prof. Fessenden while in the employ of the Agricultural Department. Prof. Fessenden worked on this system for over a year before he entered Government service, and out of the total six years spent in the work but two years were spent in Government service. Also, of the total sum expended in developing the system, less than 7 per cent. was furnished by the Government, the remaining 93 per cent. being furnished by Prof. Fessenden and his partners.

4. The Navy Department is not committed in any way to the Slaby-Arco system. At the time when the Slaby-Arco apparatus was first installed, the Navy Department held that the prices asked by the Marconi and Fessenden Companies were too high, and never made any test of either of these systems. Tests were made of the Braun, Slaby-Arco, Lodge, De Forest and American Wireless systems. As a result, the Slaby-Arco system was adopted, but the fact should be clearly understood that neither the Marconi nor Fessenden apparatus was permitted to enter the competition on account of the prices asked.

The apparatus purchased, i. e., the Slaby-Arco, infringed the patents of both the Fessenden and Marconi Companies, but these companies had no recourse for the following reason:

It is impossible to sue Government Departments except where a contract has been made. This question has been decided several times in the Court of Claims, and though several judges have pointed out the inequity of the situation, the fact remains that the only remedy an inventor has, should the Government decide to use his inventions without paying for them, is by getting a special act of Congress passed. This, of course, practically no company in the early stages of its formation is able to do, and under the present laws Government Departments can and do habitually appropriate the property of inventors, without the inventors being able to obtain any redress.

From one point of view the situation is not as outrageous as it seems to the inventors, for the reason that it is the function of a Department to carry on its work in the most efficient way possible, and it cannot be expected to take up legal questions. Again, in many cases the inventor has a recourse in being able to sue the party who sold the apparatus to the Government, and if the seller is a responsible party can recover damages. Therefore, on the whole there would be no objection to the Departments acting in this way, *provided that they purchased apparatus only from responsible agents inside of the United States, and ones capable of giving bond to pay damages.*

However, this was not the case with the Slaby-Arco apparatus, as the apparatus was purchased abroad through a foreign agent, and imported free of duty. Under these circumstances, in spite of the fact that the Slaby-Arco Company infringed Prof. Fessenden's apparatus in several fundamental points, and in fact was merely a combination of the Fessenden and Marconi apparatus, neither of these companies had any recourse.

These companies, therefore, labored under the peculiar disadvantage that they were competing against a foreign company which manufactured its apparatus abroad where the labor costs less than half what it does in the United States, which had its apparatus introduced in the United States duty free by the Government, and which, by candidly appropriating the Fessenden and Marconi inventions, was thereby relieved of the enormous cost of experimental investigations.

The somewhat ludicrous situation is thus presented of a foreigner who had appropriated the ideas of an American inventor, receiving decorations and grants of large sums of money from his own government, while the American Government was purchasing this pirated apparatus, and introducing it free of duty on the ground that the American inventor asked too much, and in spite of the fact that the American Company had tendered exactly the same class of apparatus.

The situation has, however, improved considerably of late. There is this to be said for the Navy, that when the facts were finally placed plainly before the Department they realized at once the fact that the American company had not received justice in the matter, and it may be stated with some degree of certainty that the American systems will have an opportunity of showing what they can do, and that should any foreign apparatus be bought it will be bought of responsible agents residing in this country, and capable of paying damages should they be assessed against them by a court. The question of which system is to be adopted by the Navy is at the present moment an open question.

5. The Army is not experimenting with a combination of the De Forest and Signal Corps systems. The Signal Corps installed two stations at Forts Wright and Schuyler, and tried a number of

systems, including the Lodge, Slaby-Arco and De Forest. None of these were successful, until the De Forest Company manufactured two liquid barretters of the type invented by Prof. Fessenden, whereupon immediate success was had. The De Forest Company had sold the liquid barretter to General Greely before the National Electric Signaling Company became aware of it, and immediately upon learning of it the National Electric Signaling Company commenced suit against the De Forest Company, but the suit will not come up for hearing before October or November next. General Greely thereupon took the position that he would decline to buy apparatus from any company until the ownership of the patents was decided, and meantime instructed his officers to arrange a system solely with a view to its utmost efficiency, stating that the Department would later compensate the inventors when the ownership of the patents was decided. The system in use by the Army was, therefore, arranged by the officers of the Signal Corps, and is known as the Signal Corps' system. No company has any authorization to use its name in connection with the Alaska apparatus, and in view of the fact that the system embodies the wave chute (rendered necessary by the frozen ground of Alaska), the multiple vertical, the high frequency tuned steel guy supports, the tuned condenser circuit for prolonging the oscillations at the sending end, the liquid barretter, and closed tuned circuit at the receiving end, etc., covered by the Fessenden patents belonging to the National Electric Signaling Company, if the name of any company is used it should be that of the National Electric Signaling Company.

With reference to the ELECTRICAL WORLD AND ENGINEER'S editorial on the morality of a government appropriating the wireless business, this company naturally has the same opinion. While there have been many cases where the Government has acted unjustly and improperly, it is not believed that matters have yet got to such a point that a socialistic scheme for stealing property developed at an expense of hundreds of thousands of dollars can be rushed through Congress, either now or for many years to come. When the time comes that the American people are willing to see several hundreds of thousands of young men and girls working for from $3 to $5 a week with the ultimate prospect of just getting enough to pay their board, in order to keep down an annual telegraphic deficit, as is now the case in England and Germany, the times may ripen for such an act. But not now.

NATIONAL ELECTRIC SIGNALING COMPANY,
H. J. GLAUBITZ, *Manager.*

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Transformer Oil.—SKINNER.—An illustrated article in which the author discusses the properties required from oil for transformers and describes the methods of testing. Tests of the insulating value of an oil are made by determining its dielectric strength; the general method is to immerse a spark-gap in the oil, the gap being set at a known distance, and to gradually raise the potential until rupture occurs. The author gives very distinct rules on this test, also on the flash and fire test; he discusses evaporation, the deteriorating effect of moisture, the viscosity, the cold test, the color, the detrimental effect of sulphur compounds in the oil, and the formation of deposits. Transformer oil should be a pure mineral oil obtained by fractional distillation of petroleum unmixed with any other substance and without subsequent chemical treatment. The flash test of the oil should not be less than 180° C. (356° F.) and the burning test should not be less than 200° C. (392° F.). The oil must not contain moisture, acid, alkali or sulphur compounds. The oil should not show an evaporation of more than 0.2 per cent. when heated at 100° C. for 8 hours. It is desirable that the oil should be as fluid as possible and that the color be as light as can be obtained in an untreated oil.—*Elec. Club Jour.*, May.

REFERENCES.

Three-Phase Motors.—GROB.—For testing three-phase induction motors it is valuable to have simple and exact methods for determining the efficiency, phase difference, overload capacity, slip, etc., by means of simple measurements. This may be done with the diagrams of Heyland and Ossanna. The author develops a new and relatively simple diagram in which the effect of the ohmic voltage drop is taken into consideration (which was not done in the first Heyland diagram).—*Elek. Zeit.*, June 2.

Induction Motor.—BREGUET.—A mathematical article, illustrated by diagrams, on the Behrend-Blondel-Heyland diagram of induction motors.—*L'Eclairage Elec.*, May 21, 28.

Single-Phase Commutator Motors.—LEHMANN.—A theoretical paper in which he first briefly discusses the windings of such motors and then gives the theory of the repulsion motor.—*L'Eclairage Elec.*, May 28, June 4.

Repulsion Motor.—CARTER.—The first parts of an illustrated serial on the properties of the repulsion motor.—Lond. *Elec. Rev.*, May 27 and June 3.

Railway Motor.—ROBERTSON.—An illustrated article on the winding of a railway motor armature. He describes the construction through its different processes of manufacture, the Westinghouse No. 12A railway motor armature being taken as example.—*Elec. Club Jour.*, May.

Machine Design.—LOEWY.—In a continuation of his illustrated serial on improvements made during 1903 in design of electric machines, he deals with induction motors.—*Zeit. f. Elek.* (Vienna), May 22.

Two-Phase Synchronizer.—PERCY.—A description, with dimensioned drawings, of a two-phase synchronism indicator of the revolving light type.—*Am. Elec.*, June.

LIGHTS AND LIGHTING.

Street Lighting.—HALLBERG.—A full discussion of the system of street lighting by means of small candle-power enclosed arc lamps. They consume about 250 to 300 watts at the arc, and are operated either with direct or alternating current, and are connected either in multiple or in series. The advantages of these four systems are discussed in detail and for parallel connection of the lamps it is shown that the alternating-current system has about 10 per cent. higher efficiency than the direct-current system, but requires the installation of about one-third more in generator and transformer capacities. For series connection of the lamps the alternating-current system is also more efficient than the direct-current system and requires about the same generator capacity. From the central station operator's point of view the series alternating-current system is the most advantageous, the series direct-current system comes next, the multiple alternating-current system third and the multiple direct-current system is last.—*Am. Elec.*, June.

POWER.

Electric Elevator.—JAMES.—An illustrated lecture on the present status of the electric elevator. The direct-current drum type machine, with the most modern method of control, gives very satisfactory results up to a speed of 300 ft. per minute. The cost of maintenance of this machine is reasonable where it receives proper attention, the depreciation being less than 10 per cent. Direct-current electric machines of other types which have been designed to compete directly with the higher speed hydraulic elevators, have not yet come into general use. These machines are too complicated in control and design, too expensive to buy and maintain, and some types have not yet proved that they are entirely reliable in their action. A large number of direct-current machines have been built for speeds of 500 and 600 ft. a minute and are now in successful operation, but they have not so far gained the confidence of the public at large nor the unanimous confidence of elevator engineers. Direct-current electric furnace hoists up to 300 hp have been built and installed to run up an inclined plane 300 or 400 ft. a minute with large loads, and stop automatically at the top and the bottom; these machines have been in operation for several years, and are entirely satisfactory, but their cost is greater than that of steam furnace hoists and for this reason

they are not as extensively used as their satisfactory operation warrants. For the induction motor the most promising field in elevator work seems to be in connection with hydraulic installations where the induction motor is used to drive a centrifugal pump. No installations using the centrifugal pump have yet been made, but the matter is in such shape that there probably will be several of them in operation shortly. These motors are being used with success to operate triplex pumps by allowing the motor to run constantly and by-passing the pump automatically when the pressure reaches the desired point.—*Elec. Club Jour.*, May.

Thermal Storage System.—An illustrated article on the Kensington and Notting Hill joint electric works, which supply three-phase currents at 5,000 volts to sub-stations. When extensions became necessary it was found there was room to place a 1,000-kw Parsons turbo generator in the engine room, but an extension of the steam-raising plant was a more difficult problem. It was decided to apply the Druitt Halpin thermal storage system and this experiment has been "conspicuously successful." The main idea of the system is roughly to increase the rating of the boilers at the hours of peak load, by feeding the boiler with water at boiler temperature during those hours, this water having been previously heated to the desired temperature by live steam during the hours preceding the peak hours. Additional boiler plant would, of course, only have been needed to deal with the maximum load for the two or three hours that the peak continues, and thus a substantial increase in the rate of steaming during this period is all that was required. It was found that the expedient answered even better than was anticipated, for an actual increase of boiler efficiency was observed, owing to the improvement in circulation, occasioned probably by the more steady feeding at boiler temperature when the boiler is working at its extreme output. Fig. 1 shows the arrangement adopted. The water tube boilers,

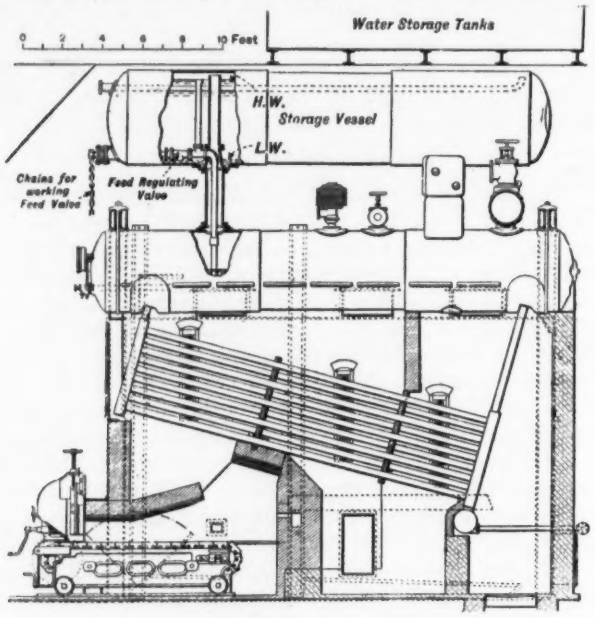


FIG. 1.—THERMAL STORAGE.

which are capable of evaporating 12,000 pounds of water per hour, have two steam and water drums, each 4 ft. in diameter by 24 ft. long, and the thermal storage vessels are placed directly above them, being carried at one end by a 10-in. stand pipe and at the other end by sliding cast-iron saddle pieces. The stand pipe forms a prominent connection to the steam space of the drums of the water tube boilers, so that the temperature and pressure in the boiler and in the thermal storage vessels are always equal. The whole of the feed water, after passing through the feed heaters (heated by the exhaust from the auxiliary engines), and the economizers, is introduced directly into the thermal storage vessel at the top, where, in passing through the steam, it is heated to the full boiler temperature, and it enters the boiler through the feed regulating cock, which is controlled by a spindle passing through a gland in the end plate of the thermal storage vessel. During times of light load the vessel is filled up, and when the heavy load comes on the feed from the pumps is stopped, and the boilers are fed from the water contained in the thermal storage vessels. During time the vessels are being discharged, the boilers are capable of evaporating two to three times the amount of water they can deal with when being fed from the economizers in the ordinary way. The extraordinary gain in the evaporation capacity would, however, not be attainable in the case of every boiler. The boilers at the station in question were originally arranged so that there should be more space for the furnace and freer excess of air to it than in accordance with the usual practice. The boiler tubes were elevated three feet higher than usual, so that the firebrick-lined combustion chamber is formed directly over the fire. There are two firebrick arches instead of one, and the flame-plate division wall between the furnace and the middle chamber is nearer the front of the boiler than usual, so as to raise the temperature and get more work done in the middle chamber.—Lond. *Elec.*, May 27.

Steam Turbine.—Parsons, Stoney and Martin.—A long illustrated paper read before the (British) Institute of Electrical Engineers on the steam turbine as applied to electrical engineering. The authors discuss at length the development of the Parsons turbine and state that up to the present there are about 600,000 hp of turbines of the Parsons type at work and on order in England and in continental Europe in various sizes ranging up to 7,000 kw.—Lond. *Elec.*, May 27, June 3. In an editorial discussion of the paper it is said that in the discussion G. Insull, of Chicago, gave particulars concerning the 6,000-kw Curtis turbines in one of his Chicago power stations. They were stated to give results 30 per cent. better than the plant in a reciprocating engine station of 17,000 kw. Merz contributed the first independent statement of an efficiency test of a Curtis turbine, namely, a 500-kw set installed at Cork. This set consumed 20.5 pounds of steam per kw-hour, with a vacuum of 27 inches and steam at 150-pounds pressure, superheated 100° F. With a vacuum of 28½ in. and 150° superheat, the steam consumption would have been reduced to less than 19 pounds. It is said that while these results do not excel those obtained with the Parsons turbine under similar conditions, they show that there is not much to choose between the two types as far as steam consumption is concerned; according to Stoney the floor space equipment as well as the capital cost is about the same in each case.—Lond. *Elec. Rev.*, May 27.

Oil Separator.—An illustrated description of an electrical oil separator used at the Leicester electric plant for effectively removing oil from the air pump discharge. There are two large wooden tanks, each divided into five compartments, and each compartment accommodates 10 plain sheet-iron plates ¼ in. thick. All the compartments are connected up in series across a 500-volt circuit and there are five plates in parallel. The liquid to be treated is divided into two streams at one end of the tanks. It then passes into the tanks and through each set of compartments in five parallel streams. Alternate plates are cut so that liquid passes first under one plate and then over the next and so on, so that the circulation is very thorough. The Leicester plant is capable of dealing with 6,000 gallons per hour and requires 12 amp. at 500 volts. The sheet-iron plates last from two to three years. After working for a certain time, they become coated with a deposit which is easily removable by causing the current to pass through the tanks in opposite directions. The deposit then rises to the surface and is cleaned off. This is practically all the attention which the process requires. The air pump discharge water is almost an electric insulator and it is necessary to add a minute quantity of ordinary water. The action of the current is to cause the emulsified oil to coalesce, and when the liquid has subsequently passed through a mechanical filter, there is no difficulty whatever in catching the particles of oil, thus allowing the remaining water, which is exceptionally pure, to pass to the hot well. The separator can be used in conjunction with any type of filter.—Lond. *Elec.*, May 27.

Electric Installation of Mines.—Hosea.—An illustrated description of the plant of the Colorado Fuel & Iron Company at Primero. The power plant contains two 120-kw, 500-volt electric generators which furnish current for the inside haulage and for the operation of the elevators, screens and box car loaders at the tipple. They are wound for 500 volts and over-compounded 10 per cent. For hauling electric locomotives are provided with three 500-volt motors and equipped with series parallel control. They are capable of hauling a load of 228 tons on a level at a speed of six to 10 miles per hour.—*Mines & Minerals,* June.

REFERENCE.

Turbo-Generator.—Woodbury.—An illustrated article on the test of a 5,500-kw turbo-generator, being the first of eight built for a

London traction company. It gives three-phase currents at 11,000 volts and 33 cycles and runs at a speed of 1,000 r.p.m.—*Elec. Club Jour.*, May.

TRACTION.

Single-Phase Traction.—An editorial referring to a recent article of Blanck on single-phase traction. It is further pointed out that the question of track equipment has received not enough attention. The question is whether the ultimate standard practice will be to feed the motor cars or locomotives direct from the high-tension line or from a third rail supplied from transformers distributed along the line. A system of the former type is that of the Oerlikon Company. The principle of this system is that the current-collecting device ought to follow the trolley wire and not vice versa; this makes a cheap and safe overhead construction possible. One of its weak points appears to be the shifting arrangement for the current-collecting device as a whole, which is necessary for avoiding obstructions offered to it on the line, such as tunnels, bridges with small clearances, lamp posts, etc., in stations. Concerning the Ward Leonard single-phase traction system, it is thought that this method in which the locomotive carries a sub-station in addition to its driving motors is not destined to be more popular than the Heyman locomotive in which the whole generating station was placed on the locomotive.—Lond. *Elec.*, May 27.

Tractive Resistance on Various Roads.—A note giving some figures on the tractive resistance on various roads, taken from a pamphlet of Max Schiemann. The tractive resistance on railways is from 9 to 18 pounds per ton, on tramways from 26 to 33 pounds, on good stone pavement from 44 to 55 pounds, on bad stone pavement from 66 to 78 pounds, on good macadam from 44 to 67 pounds, on bad macadam from 77 to 100 pounds, and on sand roads from 130 to 220 pounds.—Lond. *Elec.*, May 27.

REFERENCE.

Overhead Tramway Construction.—An article giving practical rules on the design, selection, arrangement and erection of overhead line material. The author deals especially with poles and line insulators.—Lond. *Elec. Rev.*, May 27.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Earthing Neutral Point of a Star-Connected, Three-Phase System.—TATLOW.—An abstract of a paper read before the Dublin local section of the (British) Institute of Electrical Engineers. He suggested an explanation for the fact that comparatively large currents which cannot be attributed to faulty insulation have been observed in the wire earthing the star connection of the three-phase alternators working in a Dublin station. He shows that the harmonic pressures of three times (or multiples of three times) the mean frequency are the same in magnitude and direction in all the three phases at any moment, whereas the fundamental and the other harmonics differ by 120° in phase in each of the three phases. It follows that in a mesh-connected winding, harmonic pressures of three times or $3n$ times the fundamental frequency, will, if present, add together and drive idle currents round the mesh, while the fundamental and remaining harmonics form balanced sets, the sum of the three pressures due to any of them taken round the mesh being zero at any moment. In the case of a star-connected winding these harmonics of the third order will tend to drive current into or out of the star point equally in all the three windings at any moment, and therefore they will be balanced, and, as far as pressures between any pair of the three wires coming from the machine are concerned, harmonics of the third order are eliminated by the star connection, and should not appear in the pressure wave. They would, however, appear in the pressure wave taken between any of the three leads and the neutral point if they happen to be set up in the windings, and the waves of pressure between lead and lead and between any lead and the neutral point would differ in form. Now, if the star point of the three-phase generator is earthed, and the three leads bringing current from the machine are in the form of a three-core, lead-sheathed cable, these harmonics of the third order will give rise to a capacity current flowing to earth from the neutral point and charging the sheath of the cable. The main potential of the three cores is not zero, but a fluctuating quantity which will give rise to a capacity current depending on the capacity between the three cores taken together and the sheath. In the Dublin cables the capacity of the two cables in parallel amounts to approximately 1.5 microfarads, and the author says that currents in the earth wire of the star of the order of one ampere or more might be expected. He expects to test his theory by bringing a coil connected to a telephone near to the earth wire, and observing the pitch of the note in the telephone.—Lond. *Elec.*, May 27.

Reverse-Current Relay.—An illustrated description of a reverse-current relay for use on direct-current circuits made by a British company. It is a moving coil polarized relay. The moving coil is operated by the fall of potential across the ammeter shunt. With current in the forward direction, the contact carried by the moving coil is held against the stop, but the effect of a reverse current, whose magnitude may be determined by a controlling spring, is to cause the moving coil to rotate and make contact in an auxiliary circuit. This auxiliary circuit contains eight Leclanche cells, and on being completed causes a small electromagnet to attract its armature. This latter closes a pair of heavy carbon contacts which complete the circuit of the tripping coil of the circuit-breaker. The object of the auxiliary circuit is to obviate sparking due to the induction of the trip coil at the necessarily light contacts carried by the moving part of the relay proper. The trip coil is connected across the bus-bars, and is constructed in such a manner that even if the bus-bar voltage should fall to ⅙ of its normal value it would be sufficiently strong to open the circuit-breaker. The connections are so made that a colored lamp is lighted immediately the relay operates, thus indicating at a distance which circuit-breaker has operated. The relay is provided with a push-button and on pressing this the device is caused to work and the circuit-breaker to open.—Lond. *Elec.*, May 27.

WIRES, WIRING AND CONDUITS.

Cable Calculator.—An illustrated description of the Callender cable calculator, designed by Hastings for the purpose of easily determining the size of conductor which should be used under any given conditions. The apparatus is made up of a series of discs mounted upon a common spindle, each having a logarithmic scale upon its periphery. There are six factors which determine the size of the cable, viz.: power, distance, difference of potential, power factor, loss per cent. allowed, and the system of distribution employed. In the apparatus each of these factors is represented by a disc, and the seventh disc, which is fixed to the shaft, accumulates the sum of the movements of the other discs, thereby giving immediately the result of the conditions under which the cable has to work.—Lond. *Elec.*, May 27.

REFERENCE.

Telephone Cables.—SCHMIDT.—An illustrated article on the manufacture of multicore telephone cables with air insulation.—*Zeit. f. Elek.*, (Vienna), May 29.

ELECTRO-PHYSICS AND MAGNETISM.

Stationary Electric Waves.—FLEMING.—A description of an elaborate apparatus exhibited at a recent Royal Society conversazione for the study of stationary electric waves on spiral wires. The apparatus consists of a long solenoid of silk-covered wire, having 5,000 turns and a total length of 643 meters. This solenoid has parallel to it an adjustable earth wire and a divided scale. The solenoid is connected to one point on an oscillatory electric circuit, consisting of a couple of Leyden jars, having a capacity of 0.00068 microfarads, an adjustable inductance between 0 and 230 microhenrys and a silent discharger. When oscillations are set up in this circuit by induction coil discharges and the frequency adjusted, stationary electric waves are started in the solenoid. The position of the loops and nodes is ascertained by the use of a series of carbon dioxide vacuum tubes. The position of the first node is always well defined. According to the theory the distance from the end of the solenoid to the first node should be to the distance between the first and second nodes as 1 to 2.5, and the distance between the first and second nodes should be half the wave length. Experiments with the apparatus gave a mean value of 1 to 2.4 for the above ratio. The inductance of the long spiral is 100 microhenrys per centimeter of length and its capacity is 26×10^{-8} of a microfarad per centimeter of length. From these data it is found that the velocity of the wave along the spiral is about 196 centimeters per second. From the wave lengths experimentally determined, the corresponding frequencies are then found, and these accord substantially with the frequencies as calculated.—Lond. *Elec. Rev.*, May 27.

Radiographs.—D'ARSONVAL.—A paper giving a series of radiographs and showing how they can be produced by the same tube in

an identical manner after a considerable interval of time and after using the same tube for various purposes in the meantime. He uses a milliammeter specially constructed by Gaiffe, in conjunction with an alternating-current transformer, raising the voltage from 110 to 60,000. There is also a rheostat and a voltmeter on the primary from which the effective voltage in the secondary may be determined. The current is taken from the supply network. The rest of the arrangement is that designed by Villard. The special milliammeter is only in circuit with the X-ray tube. The radiographs reproduced show that the quantity and quality of the radiation were the same in every case. A given tube may always be brought back to the same conditions of emission. When the pressure is the same, the intensity of the radiation is proportional to the current strength. The new apparatus enables radiographers to repeat any exposure under precisely the same conditions.—*Comptes Rendus,* May 9, Lond. *Elec.,* May 27.

Penetrating Radium Rays.—PASCHEN.—An account of an investigation in which he found that the γ rays, or penetrating radium rays, are not analogous to Röntgen rays, but are cathode rays or electrons moving with the velocity of light. If radium bromide is enclosed in a continuous casing of lead 1 cm. thick, the γ rays are capable of penetrating that thickness of lead, but the other radium rays are not. In spite of the packing, the positive charge of the radium preparation increases steadily by several volts per minute, which can only be due to the fact that the escaping γ rays carry a negative charge with them.—*Ann. der Phys.,* No. 6; abstracted Lond. *Elec.,* May 27.

Thermoelectricity.—DEGUISNE.—An account of some experiments in which a copper wire was heated for a distance of about 1 cm. to red heat by means of a Bunsen burner. If the burner is then moved along the wire in the one or the other direction for about ½ cm., an e.m.f. of some microvolts is measured, the direction of the current being in the direction of the movement of the burner. An e.m.f. is also obtained if two free wire ends of the same material, one of which has been preheated, are brought into contact. The author explains his results as follows: By first heating the wire at one place its structure at this place is changed and the wire becomes softer at this point. If the burner is kept at rest, the two points in which the soft wire is in contact with the other wire are of the same temperature and, therefore, no thermo-e.m.f. is observed. If the flame is moved to one side, a difference of temperature is produced between the two contact points and a thermo-e.m.f. is produced.—*Elek. Zeit.,* May 26.

REFERENCES.

Dielectric Constant of Water.—VONWILLER.—An account of the experimental investigation of the variation of the dielectric constant of water with the temperature in the neighborhood of 4° C. Thwing had found a critical point at 4° C., the dielectric constant rising to a maximum value at that point and then decreasing with rising temperature. The present investigator could not find any indication of the large effect observed by Thwing at this temperature.—*Phil. Mag.,* June.

Röntgen Rays in a Magnetic Field.—WALTER.—An account of an experimental investigation in which he proved that if Röntgen rays pass through a unit magnetic field, or a field about six times as strong as the earth's horizontal magnetic force in our latitude, the radius of curvature of the rays, if not infinite, is certainly larger than the distance of the moon from the earth. This is another confirmation of the undulatory character of the Röntgen rays.—*Ann. der Phys.,* No. 6; Lond. *Elec.,* May 27.

Radioactivity.—P. CURIE.—The first part of an article giving a summary of our present knowledge of radioactivity, with special reference to the most recent investigations.—*Phys. Zeit.,* June 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Units.—ROBERTSON.—A communication on the completion of the practical system of electrical units. As was recently noticed in the Digest, he has suggested a system which involves getting rid of the 4π in certain equations by including it in the numerical value for μ, and the taking there of another factor, 10^7, in order to make the meter and kilogram consistent with the ampere, volt, ohm. He claims that his system is put forward as being both final and practical. It does not alter any of the given electrical units and it gives simple powers of 10 as the converting factors for the c.g.s. units of all non-electrical qualities. He emphasizes that in the present state of our knowledge there must be four fundamentals in a system of electrical units, and there is no reason why we should expect to reduce this number. We know that the square root of the product of the electric inductive capacity and the magnetic permeability is the reciprocal of a velocity, but this only enables us to express one of these in terms of the other and length, time, mass.—Lond. *Elec.,* May 27.

System of Units.—EMDE.—A very long paper read before the Berlin Electrical Society. A system of units has to fulfill the purpose of enabling the facts to be described in the simplest way. The author first gives a cursory review of the facts of electricity and magnetism and then discusses the dimensions of the various quantities and the various systems of units which have been proposed. He does not himself make proposals, but gives a very full review of the various systems of units proposed, partly with the aid of diagrams and formulas. Concerning Fessenden's proposal to make the ampere-turn the unit of m.m.f., he says that this means simply to sanction in theory what is already done by everybody in practice. The author discusses at great length the proposals made by Giorgi. In the discussion which followed Hagen claimed that international electrical congresses, like that at St. Louis, are not the place to decide about such questions, since the majority of the members of the congress would not be competent to discuss them; he thinks that such a question should be discussed exclusively by official delegates of the various countries. Goerges does not like the adoption of the ampere-turn as the unit of m.m.f., since there are m.m.f's which are not due to electric currents; he has always considered the distinction between m.m.f. and number of ampere-turns to be very useful. Emde called attention to the double sense in which the term kg. is used, sometimes as a unit of mass and sometimes as a unit of weight. He suggests the name hyl for the unit of mass.—*Elek. Zeit.,* May 26.

Variable Resistance.—An illustrated description of a simple and convenient arrangement for obtaining a variable resistance to work in conjunction with banks of lamps or resistance racks to give finer regulation of current. As shown in Fig. 2, five incandescent lamps

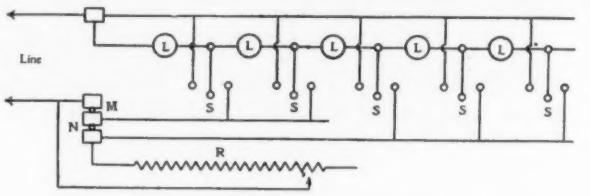


FIG. 2.—VARIABLE RESISTANCE.

are connected in series with the hinge jaws of the single-pole, double-throw switches. A german-silver resistance coil, with sliding contact, is connected by blocks at *M* or *N*, so that it may be used in series with various combinations of the lamps. The end lamp has twice the resistance of any of the others. If the coil be designed to have a resistance equal to that of a lamp, it will be seen that by proper arrangements of the switches and adjustments of the coil a great number of values of resistance may be obtained, which will range from a maximum, when the lamps are in multiple, to a minimum when the lamps are in series. Somewhat greater flexibility is attained by using two coils instead of one and connecting them in series or parallel as the occasion may require. This device is especially desirable for use in testing and calibrating instruments where very small currents are often used and where small changes of current values are necessary.—*Elec. Club Jour.,* May.

REFERENCES.

Measuring Small Capacities with an Adjustable Standard Capacity.—GERDIEN.—An illustrated article in which the author describes an adjustable condenser which he has found useful as a standard instrument. It is essentially a combination of two coaxial cylinders, one placed in the other, the capacity being changed by pushing the inner cylinder more or less into the outer one. He then describes a simple method for using this standard condenser for measurements of small capacities.—*Phys. Zeit.,* June 1.

Electric Micrometer.—A note on an electric micrometer exhibited by Crompton at the recent Royal Society conversazione for measuring screws or other small mechanical parts. It is arranged so that a contact of the part with the micrometer screw is detected by the click of a telephone in circuit with the parts. This method is ex-

tremely delicate and very easily manipulated.—Lond. *Elec. Rev.*, May 27.

Measuring Currents in a Three-Phase System.—An illustrated note on a method used in switchboard wiring where it is desired to measure the currents in a three-phase system by means of one ammeter and only two series transformers, instead of three, which are usually necessary.—*Elec. Club Jour.*, May.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Magnetic Wave Detectors.—ARNO.—An illustrated description of a rotary-field detector of Hertzian waves. Ferraris has demonstrated that an iron cylinder is caused to rotate when placed in a rotary magnetic field, even when the cylinder is sectioned in such a manner that no Foucault currents can be induced in it; the rotation is then due to magnetic hysteresis, i. e., to the drag caused by the magnetization of the iron lagging behind the rotation of the magnetic field. If the iron cylinder is subjected to the action of a rotary field and at the same time to a high-frequency oscillating field, then its behavior indicates the existence of the latter. He proved this by suspending in a rotary field, by means of bifilar suspension, a disc consisting of a mixture of iron and steel powder and paraffin wax, on which was wound a coil having one end connected to earth and the other to the vertical air wire. After having read by means of mirror and scale the deviation of the disc under the action of the rotary field alone, the oscillator was brought into action, and a distinct increase in the deviation of the disc was observed. In order to increase the sensibility of the apparatus he now uses the arrangement shown in Fig. 3. The initial deviation of the moving member

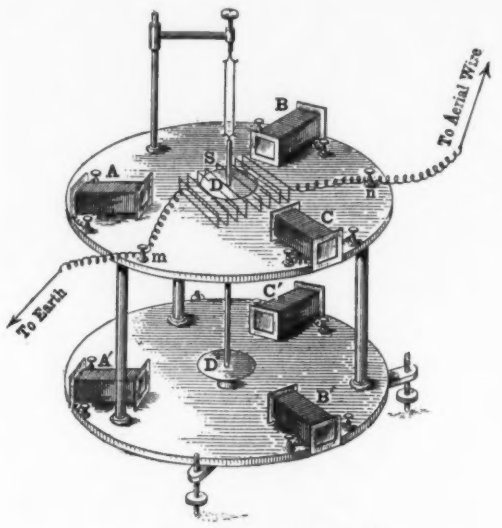


FIG. 3.—FERRARIS FIELD DETECTOR.

is always zero, whatever the intensity of the revolving field; for this purpose two perfectly equal discs, D and D^1, of magnetic dielectric material are suspended in two magnetic fields of the same intensity revolving in opposite directions; these two fields are obtained by means of the electromagnets, A, B, C, A^1, B^1, C^1, inserted in the three circuits of the three-phase system. Only one of the two discs is placed within the spiral, S, by which the terminals, m, n, are connected to earth and to the vertical air wire.—Lond. *Elec.*, June 3.

Duplex Telegraphy.—A note stating that a telegraph line from Vienna to Czernowitz about 650 miles long, had gradually become inadequate for the increasing traffic from Vienna to the southeast of Europe. As a second line would have cost about $62,500, it was decided, in spite of the fact that the line consists of iron wire, to try the differential system of duplex telegraphy, the cost of which amounted to but $1,040. The experiment succeeded and the system has now been working satisfactorily for some weeks.—Lond. *Elec.*, May 27.

MISCELLANEOUS.

REFERENCES.

Electrical Laboratory.—HOCHENEGG.—A fully illustrated description of the Electrical Laboratory at the Institute of Technology of Vienna. Three-phase and direct currents are available, the latter being supplied partly from the outside mains and partly from a storage battery. For the illumination of the lecture room 48 osmium lamps, each of 50 candles, are arranged in the ceiling, while the demonstrating table is illuminated by thirty-six ordinary candle lamps of 16 cp. This method of illumination is said to be very effective.—*Zeit. f. Elek.* (Vienna), May 1.

The Young Engineer.—SCOTT.—A reprint of the major portion of his address to the graduating class of 1903 of the Stevens Institute of Technology, on the young engineer and his opportunity.—*Elec. Club Jour.*, May.

New Books.

READY REFERENCE TABLES. Vol. I: Conversion Tables. By Carl Hering. New York: John Wiley & Sons. 196 pages. Price, $2.50.

This valuable reference book is very appropriately introduced by a quotation from Lord Kelvin as follows: "I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer." While many of the tables in the book would not be rendered superfluous if the metric system were in universal use, yet a glance through the pages reveals a distressing situation incident to the use of the English system of weights and measures. It is really refreshing when one comes to the section of the book devoted to electrical units and measurements which, forming part of the broad metric system, are naturally not handicapped with the burden of empiric, arbitrary relations which the English system imposes in other departments of applied science.

In this first volume all the various measures used in practice, and more especially those employed by engineers and physicists, are given, with their values expressed in terms of correlated measures likely to be used in practice. The reciprocals are also given, thus enabling every calculation involved in the conversion of one measure into another to be reduced to a single multiplication. The plan of the work involves the inclusion of every unit of measure used in practice, besides many that are now obsolete, but occasionally met with. Several hundred of the more usual foreign units or measures are also included.

A valuable feature of the book is that the conversion factors have not been merely compiled, but were all specially re-calculated for this volume under the direction of the author, from the exact legal values or the most authoritative data attainable where no legal value exists. In the preface it is stated that the calculations were in many cases made by two entirely different methods and the resultant values checked and cross-checked, often several times. In some cases the values were checked by the original authorities after the pages were electrotyped. A useful feature consists of approximate figures for values to the nearest fraction or other abbreviated number easily memorized, the approximations all being within two per cent. In many of the tables the logarithms of the values to seven places are given.

The introduction deals with the inter-relation of units, distinction between units and quantities, the absolute systems of units and dimensional formulas. The main body of the book is introduced by tables giving the physical quantities and relations in use, with their names, symbols, derivation and dimensional formulas and corresponding c.g.s. unit, these tables being an extension of a similar table which received official endorsement by the Chicago International Electrical Congress of 1893. Then follow the tables of conversion factors, which cover a wide range beyond the fundamentals of length, surface, volume and mass. Among the many headings in addition to the last-mentioned are pressures, energy, tractive force and energy, power, moments of inertia, angular velocity, linear and angular acceleration, plane and solid angles, water discharges, electric and magnetic units, photometric units and thermometer scales. The final pages deal with miscellaneous subjects, such as money, paper measure, scales of maps and drawings, useful functions of π, useful numbers, systems of logarithms, acceleration of gravity, mechanical equivalent of heat, specific heat of water, etc.

The sections on electric and magnetic units supply a great need, and give information that otherwise would have to be gathered from numerous sources, some not easily accessible. An admirable feature consists in numerous formulas giving the various relations of each quantity and the other electrical and magnetic quantities, including the numerical coefficient if there is one. For example, under ohms are given the relations with volts, amperes, coulombs, watts, joules, henries, maxwells, impedance, reactance, susceptance, admittance and

frequency, thus enabling the ohms to be calculated from any two or more of these. In the same section are given many numerical values, accompanied by logarithms, of units of specific resistance, such as the mil-foot, circular millimeter-per-meter, square millimeter-per-meter, and following is a table giving the resistivity of copper and mercury in all these units and in others. Conductance, admittance and susceptance are similarly treated.

Under e.m.f. are given the values, in terms of the "international" volt, of the several volts that have been in use, and also the voltage of the several standard cells, with tables of values for the Clark and the Weston cells at different temperatures. All of the electrical and magnetic quantities are treated exhaustively along the above lines, the data collected relating to each being much more inclusive than has ever heretofore been attempted. Sections that will be of particular interest are those considering exhaustively the magnetic units and quantities, since these are given scant mention in most books.

The subject of photometric units is excellently treated under the main heads of intensity of light, flux of light, illumination, quantity of light and light efficiency, all of the many units used, as well as the system of units proposed by Blondel, being defined and inter-related quantitatively. The table giving the values of each of the second thermometer scales in terms of the others, from absolute zero to the temperature of the sun, is exceptionally interesting on account of including entries of the freezing, boiling or melting points of some hundreds of substances.

The book is prefaced by a table of symbols and abbreviations used in the text containing more than 300 entries, which should serve as an object lesson teaching the dire necessity of a uniform system of scientific and engineering notation. Though the price at which the work is published is remarkably high for a book of the size, yet it is well nigh indispensable to all who want to have at hand for ready reference the measures and values used in the physical engineering sciences. It is sincerely to be hoped that the author will supplement the volume by another giving tables of fundamental physical data, such as resistivities of solutions and metals and particularly of alloys, electrochemical equivalents, thermoelectric e.m.f's and e.m.f's of combinations of the various metals and electrolytes, Berthelot's heats of reaction, specific inductive capacities, and various other magnetic and electrical constants, many of which are not readily accessible, or when given in some publications are of doubtful authenticity.

Convention of Railway Telegraph Superintendents.

The twenty-third annual convention of the Association of Railway Telegraph Superintendents was held at Hotel English, Indianapolis, Ind., June 15 and 16. The meeting was called to order by President Charles S. Rhoads, who, in a brief address, congratulated the Association on its prosperity which, he said, is more marked at this time than at any other period in its history. He introduced the Hon. J. W. Holzman, Mayor of Indianapolis, who extended to the delegates a hearty welcome to the city. His Honor stated that he would not tender the keys of the city, as is usual on such occasions, because the gates would be left wide open during the sessions of the convention and no keys were necessary. He spoke a good word for the city of Indianapolis and the character of its citizens. Mr. Charles Selden, on behalf of the Association, responded to the Mayor's address, thanking the latter for his kind expressions of welcome.

After the transaction of some routine business several active, associate and honorary members were elected. Letters and telegrams of regret at inability to be present were read from several of the members, including Mr. Thomas A. Edison, and L. W. Stanton, of Cleveland. The morning session was concluded by the reading of the reports of the secretary and treasurer.

At the afternoon session a paper entitled "The Telephone in Railway Service" was read by Mr. A. G. Francis, railroad agent of the Chicago Telephone Company. Mr. Francis discussed the economy, development and equipment of railway signal towers. In the discussion of the paper it was brought out that railroad trains on many roads are being moved successfully on telephonic orders, and that up to the present time not a single accident, traceable to such orders, has been recorded. The subject of the paper was referred to the committee with instructions to bring the matter before the American Railway Association for the purpose of formulating orders permitting the movement of trains on telephonic orders.

Mr. F. G. Sherman, of the Central Railroad of New Jersey, read a paper entitled "The Economic Use of the Commercial Telegraph by Holders of Telegraph Franks Issued on Account of Railroad Contracts." In the discussion of this paper many abuses of the articles of contract were referred to.

At the evening session the first business was a paper by Mr. J. B. Taltavall, of New York, entitled "The Telegraph Operator in the Railroad Service." In the discussion that followed it was shown how improvements in the operation of the railroad telegraph system could be made without increasing operating expenses; and many of the members gave an account of the methods adopted by their respective roads as tending to improve the worth of the individual operator.

Mr. William Kline, of Toledo, Ohio, described the combination telephone system operated by nine of the railroads entering that city, which was used for the purpose of facilitating the exchange of business between the different roads. He stated that the results had so far been most satisfactory and that the movement of traffic had been greatly expedited. Along the same general line Mr. E. P. Griffith, of the Erie Railroad, read an exhaustive report on the subject of "Composite Circuits," which gave a list of the railroads in the United States at present using such circuits; also the results attained in each case. The interest of the subject to the members was evidenced by the fact that the discussion lasted until 10.30 o'clock, when the meeting adjourned until Thursday, June 16.

At the Thursday session the first business transacted was the election of officers and the selection of a place for the next meeting. The election resulted as follows: President, Mr. H. C. Hope, Chicago, Minneapolis & Omaha Railway, St. Paul, Minn.; vice-president, E. E. Torrey, Mobile & Ohio Railroad, Jackson, Tenn. Mr. P. W. Drew, of the Wisconsin Central Railway, Milwaukee, Wis., was re-elected secretary-treasurer. It was decided to hold the next convention at Chattanooga, Tenn., on the third Wednesday of May, 1905. President-elect Hope then assumed the chair and thanked the convention for the honor conferred upon him.

A paper by Mr. L. S. Wells, of the Long Island Railroad Company, on the subject of "The Typewriter in the Telephone Service," was then read. This was followed by a talk by Mr. William Maver, Jr., of New York, on "Recent Improvements in Wireless Telegraphy." The discussion of the subject of "Composite Circuits" was then resumed and continued until 1 p. m., when the convention adjourned.

An excellent programme of entertainment was provided for the guests and their wives, including a dinner at the Columbia Club, trolley excursions and a trip to St. Louis over the Big Four Railroad. The courtesies of the free use of telegraph and telephone services were extended to the delegates by the telegraph and telephone companies.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society was held at the Electrical Testing Laboratories, June 15. The report of the secretary showed that 101 members had been elected during the year; 54 had been dropped for non-payment of dues; 32 had resigned, and 3 had died; and that the total membership is now 631. The report of the treasurer showed that the income of the society for the year ending January 31, 1904, was $1,502.62, and the balance on hand was $34.37.

The revised constitution and by-laws were read for the second time before the society, and after being submitted to the meeting, were unanimously adopted. One essential point in the new constitution is that no officer except the secretary and treasurer shall be eligible for immediate re-election to the same office. The provision for proposed amendments is made much more stringent than formerly. One of the principal features in the amended by-laws is the provision for a nominating committee, which now consists of eight members appointed by the president, with the president ex-officio. Two of these members shall be past presidents, two shall be members of the executive committee, and four shall be non-office holding members, thus giving the largest representation on the committee to the general membership of the society.

The election of officers resulted as follows: President, Frank J. Sprague; vice-presidents, C. G. Young (re-elected), E. H. Mullin (re-elected), F. C. Bates (re-elected), Albert F. Ganz, Louis B. Marks, W. S. Rugg; secretary, George H. Guy (re-elected); treasurer, Henry A. Sinclair (re-elected).

After the business meeting the society was welcomed by Mr. John W. Lieb, Jr., president of the Electrical Testing Laboratories. Mr. Lieb gave a short history of the foundation of the laboratory, which has developed from a lamp testing bureau, founded by the Association of Edison Companies, to its present extensive and complete equipment. Since the laboratory has been opened, all kinds of electrical tests have been conducted, especially on the photometric value of arc lamps, breakdown tests of insulating material, the effect of the distribution of light due to shades and reflectors, meter tests, the standardizing of instruments, the preparation of photometric standards, etc.

Mr. Wilson S. Howell, manager of the laboratories, gave a short address on the "Importance of Testing." He showed that the matter of testing was equally important to the manufacturer and to the purchaser. Among instances given of complete testing equipments, he mentioned those of the Pennsylvania Railroad Company, the Brooklyn Navy Yard, the General Electric and the Westinghouse Companies, and it was demonstrated that the success of all those organizations was due to a great extent to their continuous testing, not only of their own purchases, but also of their own products.

Dr. Clayton H. Sharp addressed the meeting on the "Equipment of the Commercial Testing Laboratory," concluding his address with an exhibition of a number of slides, the most interesting of which were made by a triple oscillograph, showing an alternating e.m.f., and currents set up thereby with an inductance and a capacity in parallel. After an inspection of the equipment of the laboratory had been made a collation was served.

The Largest Rotary Converter.

We are glad to be able to illustrate herewith what is stated to be the largest rotary converter ever built. Although rated at 2,000 kw,

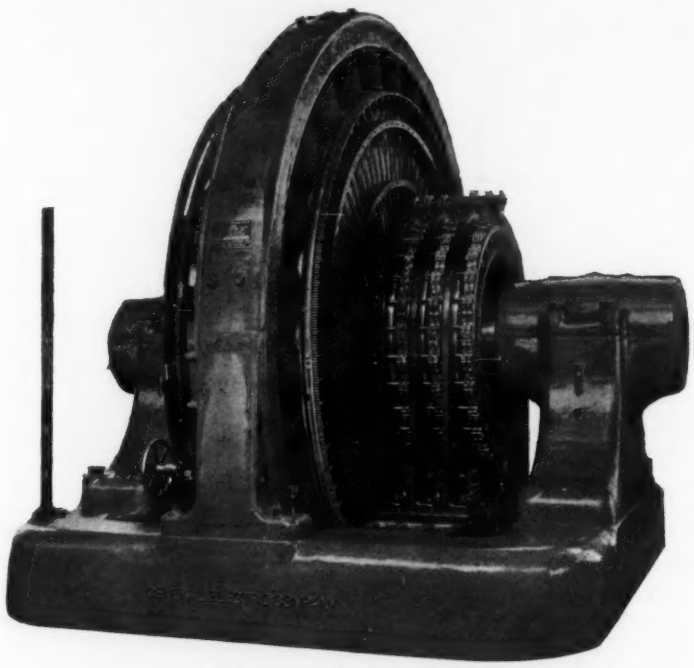


FIG. 1.—ROTARY CONVERTER.

it is actually of greater output, as the specifications call for its delivery of 2,500 kw continuously without any portion heating more than 45° C. It has met all the heating efficiency and overload guarantees with considerable margin. We are indebted to Mr. H. F. T. Erben, of the engineering department, for the data of this machine, whose design, we believe, should be credited to him.

In the nomenclature of the General Electric Company the converter is rated "HC-26-2,000-115-240/300 V.", i. e., it is six-phase, has 26 poles and operates at a speed of 115 r.p.m. Its normal full load is 7,400 amp. at any voltage between 240 and 300. Its armature is nearly 13 ft. in diameter, its commutator 11 ft., and its collector rings are 6 ft. Including the shaft, the revolving parts weigh approximately 35 tons, and the machine complete, with base and two bearings, 93 tons. The overall dimensions are as follows: Height above floor line, 14 ft.; width, 17 ft.; overall length, 15½ ft.

These converters are guaranteed for continuous operation at 7,400 amp. and 270 volts without heating more than 35° C. on any part, and for continuous operation at 9,250 amp. and 270 volts (25 per cent. overload) the temperature rise under this condition not to exceed 45° C. on any part. Immediately following either of the above conditions, 11,100 amp. at 270 volts (50 per cent. overload) for two hours was guaranteed not to produce a temperature rise exceeding 55° C. on any part. The converters have been thoroughly tested

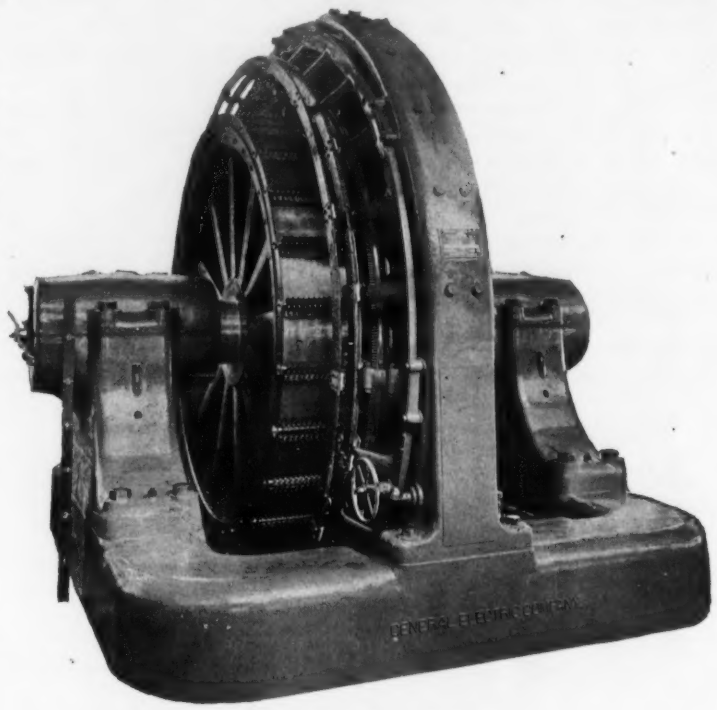


FIG. 2.—ROTARY CONVERTER.

at Schenectady under the normal and overload conditions, meeting the heating guarantees by a liberal margin and commutating throughout the range with practically no sparking at the brushes. Inclusive of all mechanical and electrical losses, the efficiencies were as follows: 1½ load, 95¾; full load, 95¾; ¾ load, 95; ½ load, 93½.

Four of these converters are to be used by the New York Edison Company on its lighting circuits.

45,000 KW Equipment for Niagara Falls Plant.

The Toronto & Niagara Falls Power Company, of which Mr. H. M. Pellat, of Toronto, is president, and Mr. F. S. Pearson, New York, consulting engineer, has just placed a very interesting contract for generators to be installed in its Niagara Falls plant.

There will be six generators of 7,500-kw capacity each. The contract was secured by the Canadian General Electric Company. The contract for the turbines has not yet been determined on.

Mr. W. P. Plummer, 29 Broadway, New York, who is purchasing agent for the Sao Paulo Tramway, Light & Power Company, Brazil, and the Mexican Light & Power Company, Limited, both of which concerns use huge quantities of Yankee equipment, supplies, etc., also acts in a similar capacity for the Toronto & Niagara Falls Power Company.

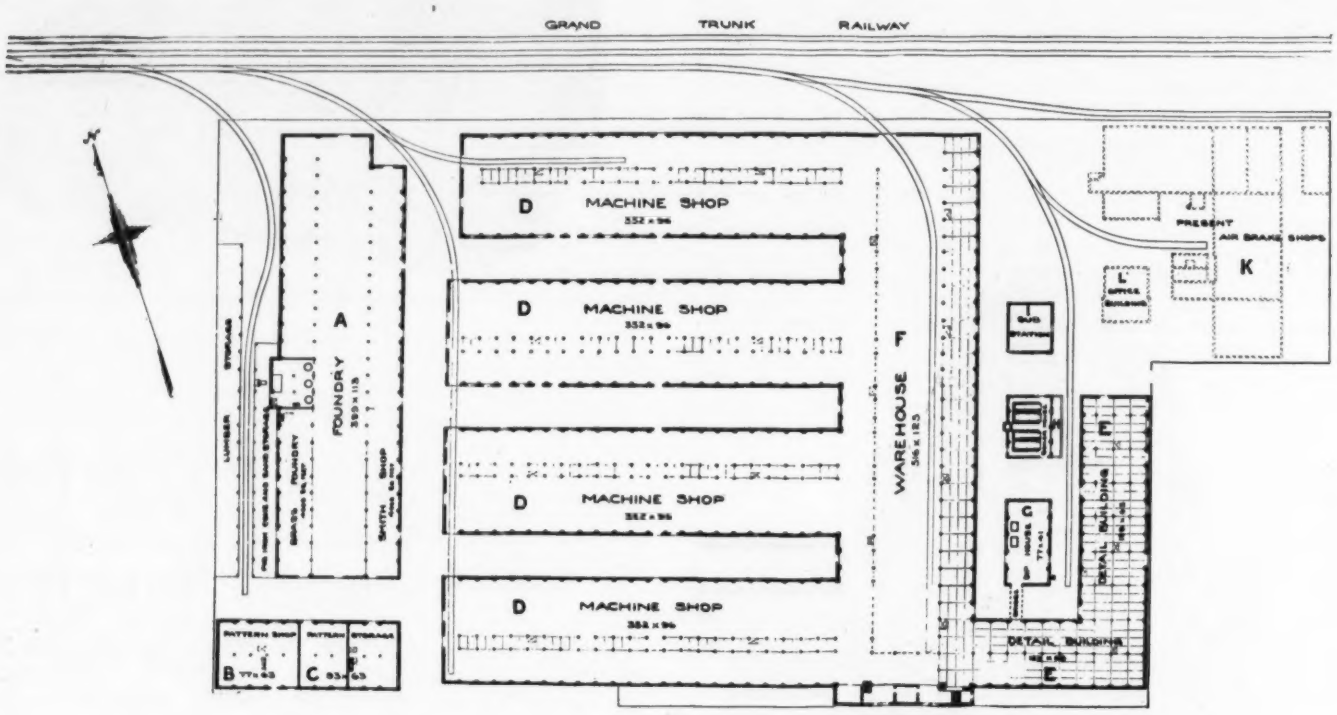
Allis-Chalmers Turbine Contract.

The Transit Development Company, acting on behalf of the Brooklyn Rapid Transit Company, has just placed a contract with the Allis-Chalmers Company for a 5,500-kw turbine to be direct-connected to a 25-cycle, 750-r.p.m., three-phase alternator, wound to give either 6,600 volts or 11,000 volts. This equipment is intended to be installed in the Kent Avenue and Division Avenue power station, Brooklyn. It will be the second generating outfit ordered for the same station, the Westinghouse interests having recently secured a contract for a 5,500-kw turbine and generator. The Kent Avenue plant, it is expected, will ultimately have a capacity of no less than 66,000 kw.

Canadian Works of the Westinghouse Companies.

The accompanying illustration gives a plan view of the new plant of the Canadian Westinghouse Company, Limited, at Hamilton, Ont. The choice for the location of the Canadian plant fell on Hamilton not only from the natural advantages of that city from the manufacturing standpoint, but as well from the fact that for a period of eight years another Westinghouse interest, the Westinghouse Manufacturing Company, Limited, has been located there engaged in the manufacture of Westinghouse air brakes. To join under one management the existing air brake business and the electrical business a new organization was formed under the name of the Canadian Westinghouse Company, Limited. Work on the electrical manufacturing plant has been vigorously pressed from the commencement, and notwithstanding an unusually severe winter, the work was not interrupted, and it is expected that the plant will be in operating condition this fall. The Canadian Company, through an agreement with the Pittsburg Companies, will have the benefit of all designs and processes of the older companies, and aided by the co-operation of many of Canada's most representative citizens the company can confidently count upon a prosperous future.

The new buildings consist of a foundry, pattern shop, pattern storage house, general machine shop, detail machine shop, insulation treating building, boiler house and transformer building. On the accompanying diagram these various buildings are lettered from A to L inclusive in the order just given, with the exception that K is the brake plant and L the office building of this plant enlarged to accommodate the increased force of the new company. In laying out the manufacturing buildings two essential points were kept in view, namely, that progress of material from raw to completed shape should as far as possible be in a continuous direction; and that while the initial installation should constitute a complete plant, it should be capable of expansion along its own lines to an extent limited only by the total available property. As to the first point, raw material received on track west of the foundry progresses in general from this point to the warehouse, from which shipments are made over tracks located within the building. As to the second point, something less than half of the total installation shown in the illustration is at present under construction, the northern half of the foundry warehouse and corresponding machine shop buildings being left for future extensions.



PLAN OF CANADIAN WESTINGHOUSE WORKS AT HAMILTON, ONT.

In the foundry the main bay is served by a 20-ton crane, the length of the building being also traversed by traveling jib cranes operated at a lower level. An electrically-driven elevator is provided to deliver iron from the yard to the charging floor, and a conveyor, also electrically driven, receives coke from railroad cars and deposits it in a bin suitably located on the charging floor. The general machine shop is arranged with a high bay covered by a 20-ton crane and a low bay served by a five-ton crane. In the former the heavier machine tools are located and it is here that mainly the stationary parts of generators and motors will be finished. The lower bay will be devoted to the preparation of rotary parts, and the gallery floor above the latter will provide space for the manufacture of commutators, brush holders, bearings, etc., and also for the tool room and the controller department. After the completed rotary part has received its winding in the eastern end of the low bay, it is passed by a jib crane along the mezzanine floor of the high bay, where it is placed in its corresponding stationary part, which has been under construction in this aisle, and the auxiliary parts are delivered at the same point by the elevator from the gallery floor.

In addition to the crane above referred to serving the main portion of the high bay, the eastern end or assembling floor is provided by an additional crane of like span, but of lower level, whereby machines can be delivered from the assembling floor under the west gallery of the warehouse into the middle bay of the latter building, where the north and south cranes can pick up the load for further handling. In the detail machine shop the ground floor will accommodate the coil winding and insulating departments, its location being convenient both for the reception of the wire from the warehouse and delivery of completed coils to the winding and assembling floors at the east end of the general machine shop. The second floor is devoted to machine work necessary on switches, rheostats, meters, instruments, arc lamps, etc., and on the third floor are the assembling and testing rooms for these lines of apparatus.

The insulating treating building is separate from the main group, since the work here involves the use of inflammable materials. Communication with the detail building is provided by a two-story enclosed bridge cut off at each end by fire doors.

Power for manufacturing and testing purposes, as well as for lighting, is to be obtained from a local electric power company, which draws its supply from Decew Falls. Current will be received for general shop purposes. All the lighting distribution will be at 110 volts and transformation to direct current will be made to supply in the transformer house at 2,400 volts and distributed at 440 volts some of the cranes and tools. Transportation between the foundry and all buildings, including the air brake plant, will be by an industrial railway operated by a storage battery locomotive. The construction of the buildings is in the hands of Westinghouse, Church, Kerr & Co., of New York, as engineers and general contractors.

Exhibits at the Railroad Telegraph Superintendents' Convention at Indianapolis.

The J. H. Bunnell Company, of New York, was represented by its president and general manager, Mr. J. J. Ghegan, and Mr. Jesse H. Bunnell. Its exhibit consisted of a line of up-to-date telegraph apparatus; also a new type of star zinc and hanger and a new straight line type of line tapping clamp. Messrs. Ghegan and Bunnell distributed souvenir match boxes.

A Adams-Randall composite circuit set was shown in practical operation. The object of this device is to increase the initial energy of telephone currents to suit conditions and requirements.

Mr. C. K. Jones, of Quincy, Ill., exhibited his automatic telegraph circuit protector and signaling machine, which has received the warm commendation of the officials of the Illinois Central Railroad.

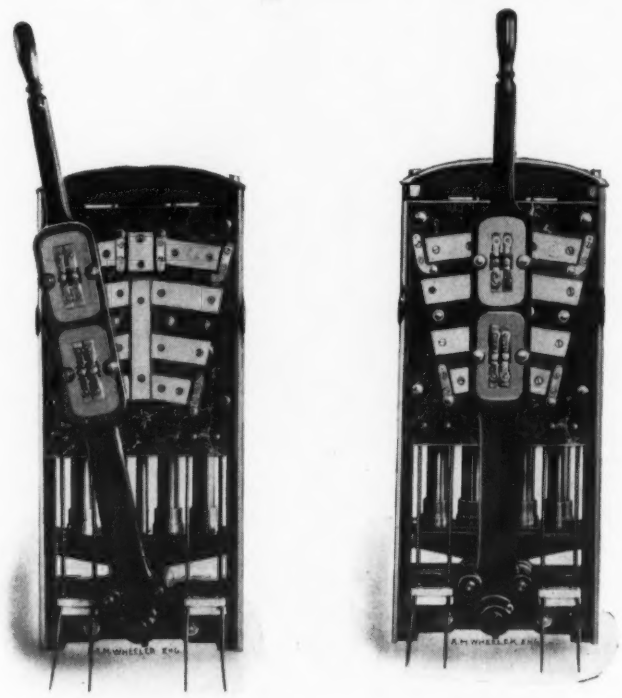
Mr. Vogel represented the Railway Supply Company, of Chicago.

The Safety Insulated Wire & Cable Company, of New York, was represented by Mr. A. P. Eckert.

The Allen-Bradley Electric Crane Controller.

The American Electric Fuse Company, of Chicago, has recently secured the exclusive manufacturing and sale rights to the Allen-Bradley electric controllers, and is now placing this line of apparatus upon the market. An exhibit of these controllers has been installed in the Electricity Building at the World's Fair, St. Louis, where they may be inspected.

While the Allen-Bradley controller is of the carbon resistance type, it differs from other carbon resistance rheostats, both in principle of operation and method of construction. The resistance medium is a column of carbon discs placed inside a non-combustible insulating tube, which in turn is enclosed within an external tube or shield. When an electrical connection is made between the top and bottom carbons, the flow of current through all of the intervening carbons will meet with a very high resistance, due to imperfect contacts between the several carbon discs. To reduce this resistance, a compression lever, operating in connection with springs, is employed to press the discs together, thereby making the contacts between them more perfect. This compression is gradually applied and affords an infinite range of control. When the compression is released, the carbons, by their natural elasticity, expand to normal condition and the resistance again becomes very great. Any desired resistance may be had by increasing the number of tubes or columns employed in the controller. A simple mechanical adjustment of the operating parts equalizes the compression upon all the tubes in the controller, as indicated in the illustrations, which show a controller having four tubes.



FIGS. 1 AND 2.—CRANE CONTROLLER.

Among the points of superiority claimed for the Allen-Bradley controller are that it has no steps or contact points, and, therefore, the current is not regulated by jerks, while the controller is absolutely free from sparking, welding and arcing. There is no limit to the control of the current flow, and a motor can be driven as fast or as slow as desired, and without danger of injury either to the motor itself or to the controller. The resistance units being entirely enclosed from the air, are not endangered by heat even when the full resistance is left in the circuit for long successive periods of time. The machine is extremely simple in construction and practically indestructible under ordinary use, excepting from external causes. It is specially designed to stand the hardest usage, and to work under the most difficult conditions without breaking down. The controller is very compact, controllers up to 40 hp not exceeding 10 in. in width. It is possible, therefore, to place a much larger number in a smaller place than any other controller. The long leverage of the handle makes it extremely easy to mnnipulate, and the most inexperienced operator cannot injure. No repairs are necessary except when a controller is injured by accident. With ordinary use, an Allen-Bradley controller will last as long as the motor with which it is used.

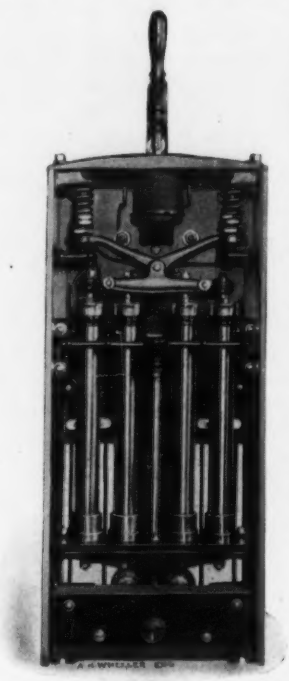


FIG. 3.—CRANE CONTROLLER.

Magnetic Apparatus.

The Electric Controller and Supply Company has designed an interesting line of magnetic apparatus, consisting of lifts, clutches and magnetically operated switches, some types of which we illustrate herewith.

FIG. 1.—LIFTING MAGNET.

Figs. 1 and 2 show lifting magnets in operation. This apparatus is made for the handling of pig iron, ingots, blooms, slabs, billets, bars, plates, rails, structural shapes, iron and steel pipe, and many

other raw and manufactured products of iron and steel. A single design of magnet is not adapted to handling the full range of material above mentioned, and the magnet is designed to meet the form of material to be handled. For instance, there is a wide difference in the design of a magnet for lifting ingots or blooms and one adapted to the handling of thin plates. A magnet which would handle five tons in the form of an ingot might not handle five hundred pounds in the form of thin plates. The company has secured complete lines of data through the testing of some forty designs of magnets on a testing machine constructed for this special purpose.

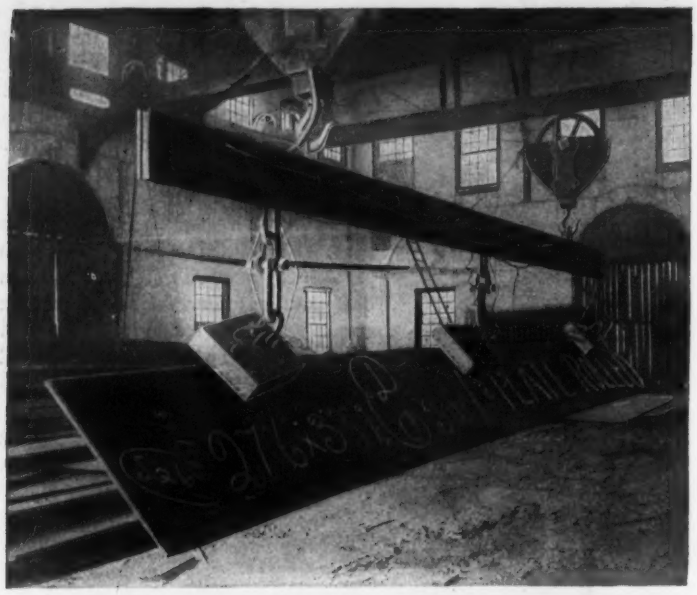


FIG. 2.—LIFTING MAGNET.

In Figs 3 and 4 are shown the "magnetic cushion" type of electromagnet designed to overcome the objections to the employment of the usual type for lifting and other purposes. The initial pull of the magnet through the air gaps encountered in common practice is fully equal to that of a plugged or stopped type of magnet of equal weight, and a most desirable characteristic is obtained, in that the curve of tractive force is almost a horizontal line, which obviates rapid acceleration of the plunger toward the end of the stroke. The motion of the plunger is arrested simply by the action of the magnetic field, which gives rise to the designation "Magnetic Cushion." No mechanical stop is provided and there is no blow or shock when the plunger is brought to rest at the end of its travel. The magnet plunger, therefore, is silent in operation. For operation in exposed places, the winding of the magnet is completely enclosed and protected by the ironclad construction of the return magnetic circuit.

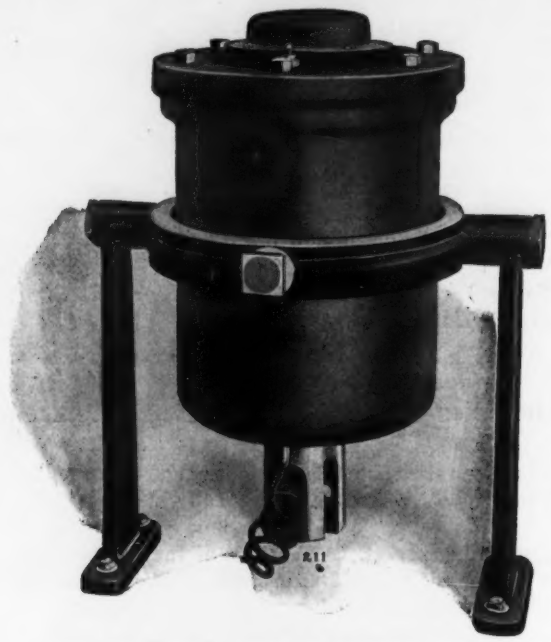


FIG. 4.—GENERAL VIEW OF ELECTROMAGNET.

Fig. 5 shows a gravity type of magnetic switch, made in capacities from 1 to 150 amperes. In opening an electric switch circuit carrying a heavy current the switching device employed should meet the following requirements: First, it should open instantaneously; second, its contacts should be protected by a powerful magnetic blow-out, and third, in opening, its contacts should invariably be separated to such an extent that the magnetic blow-out will be instantly effective in rupturing any arc which may be formed. In closing, the switch should act promptly and positively, and the current carrying contacts should be drawn together and held with sufficient pressure to cause intimate contact between their surfaces. The switch illustrated

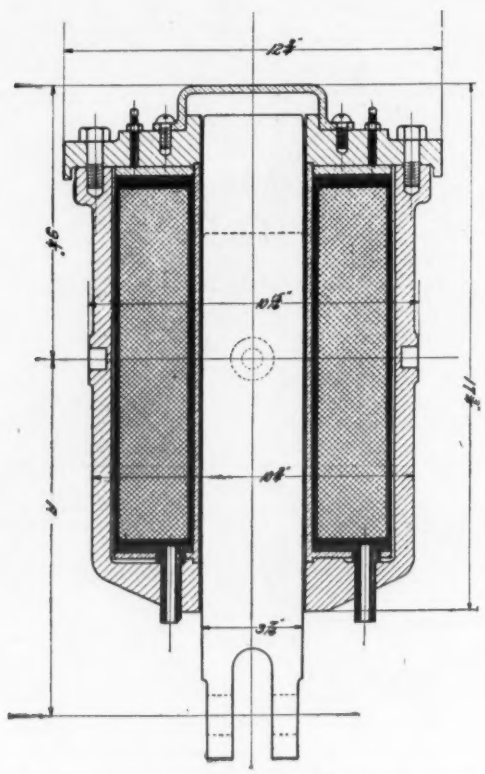


FIG. 3.—CROSS-SECTION VIEW OF ELECTROMAGNET.

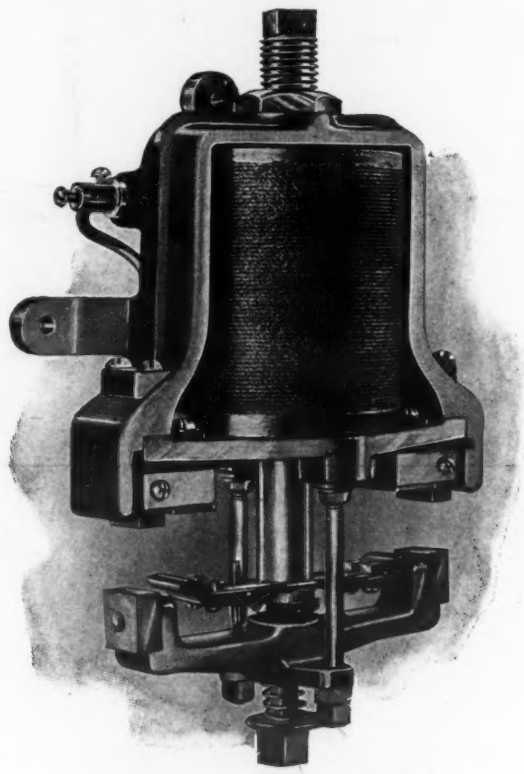


FIG. 5.—GRAVITY MAGNETIC SWITCH.

is claimed to possess all of the above characteristics together with other valuable features of its own.

The switch is closed by the direct action of a vertical electromagnet on a movable plunger which carries the contact arm of the switch, and is opened by the action of gravity on the plunger and contact arm, the weight of which is sufficient to produce instantaneous separation of the contacts.

The main contacts of the switch are of copper and are protected by auxiliary contacts of carbon so arranged that the final opening of the circuit always takes place at the carbons, thus protecting the main

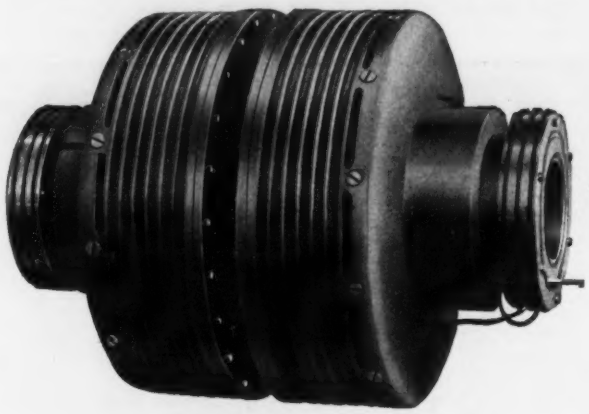


FIG. 6.—MAGNET CLUTCH.

contacts from the effect of arcing of even momentary duration. The construction of the switch is such that the frame of the electromagnet and the arm which carries the movable carbon contacts direct a heavy magnetic flux in the path of any arc which may be formed when the circuit is opened. The pressure between the current-carrying contacts when the switch is closed is produced directly by the pull of the magnet and is therefore positive and constant.

In Fig. 6 is illustrated a large magnet clutch designed for the rapid reversal of a very heavy load, a considerable amount of heat necessarily being generated at the friction surfaces at each reversal. The friction element of this clutch is composed of a plurality of friction plates, keyed alternately to the driving and driven elements and constantly bathed in oil, which serves to lubricate the plates and at the same time transmits the heat to the retaining case, where it is readily dissipated at the corrugated surface of the case.

Electrical Exhibits at the World's Fair, St. Louis.

The handsome booth on the Edison space is divided into three sections, the central one being the headquarters of the American Institute of Electrical Engineers, the one on the right being the office

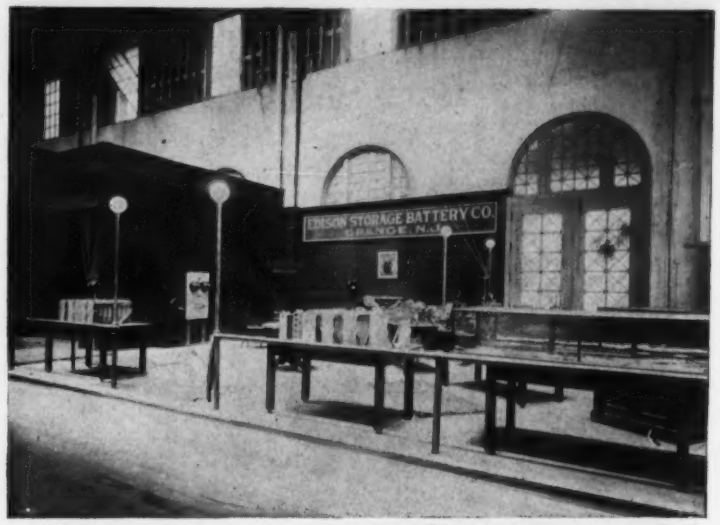


FIG. 1.—EDISON STORAGE BATTERY EXHIBIT.

of the Association of the Edison Illumination Companies, and the third the office of the Edison historical exhibit. The Edison Storage Battery Company's exhibit occupies an adjoining space. Here are shown three of the latest types of the new Edison battery, one cell of each type having part of the side cut out to show the internal construction. A 40-cell automobile battery is connected to a charging board to show the conditions under variable rate of charge and discharge, and demonstrates the high rates which can be used without effecting the battery. In one show case are the different parts used in the construction of the cells. Plates are exhibited from a cell of an automobile which has run 4,000 miles over rough roads and show practically no deterioration. In another case is shown an historical collection of Edison storage cells beginning with the first cell made and showing one of each type. There are also bottles containing the nickel and iron oxides and graphite used in filling

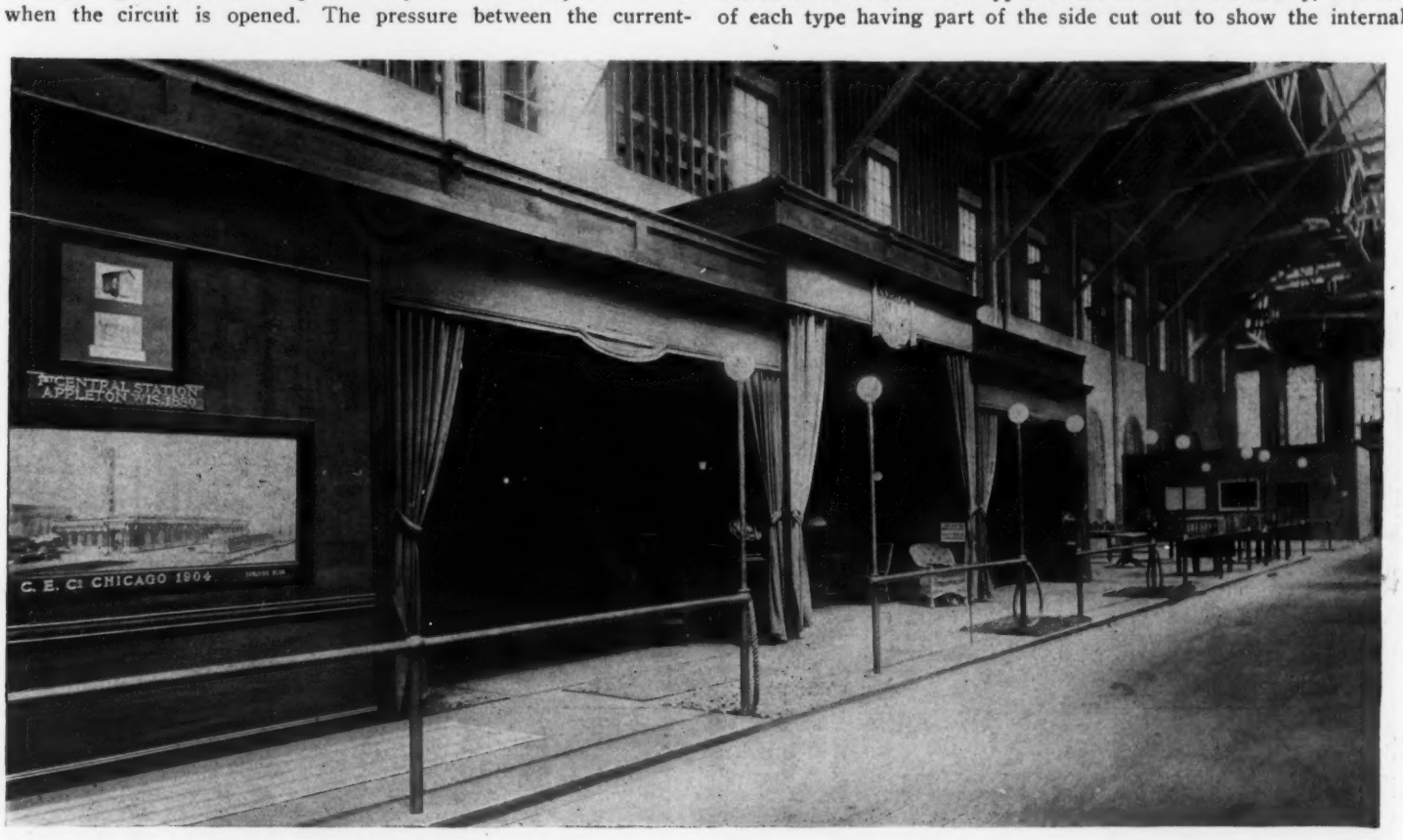


FIG. 2.—BOOTHS IN EDISON SPACE.

the pockets of the plates. One bottle contains the electrolyte with all the sediment from a cell, which has gone 5,000 miles in an automobile. Only a very thin layer can be seen on the bottom of the bottle. On the wall are some enlarged curves showing battery voltage at various discharge rates. The exhibit also contains ten different types of the Edison-Lelande primary battery and some battery fans operated by them. Several of the Edison projecting kinetoscopes are displayed.

Some of the small motors and generators of the Roth Bros. & Co., Chicago, are adapted to special lines of work. One dynamotor of the transformer type is used by telephone exchanges for ringing bells

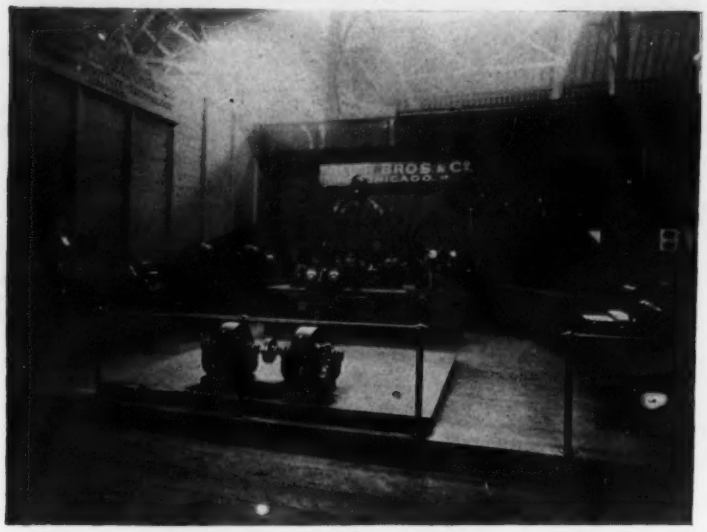


FIG. 3.—ROTH BROS.' EXHIBIT.

with attachments for the "howler," "busy back," "automatic ringing" and "pulsating current" for party lines. Electric grinding and polishing lathes, forge blowers, motor-generator charging sets, motors for 1/16 hp to 15 hp form interesting features of the display. A motor-generator set will furnish light and power for the exhibit.

The Electric Controller & Supply Company is exhibiting in Section 5 an entirely new system of control where the service requires frequent reversals of the driving motor under load. This control has been applied chiefly to the table motors in steel mills where a stop from full speed and acceleration to full speed in the reverse direction of a 50-hp motor under load is required in less than 30 seconds. The adaptation of this system to the operation of planers is shown

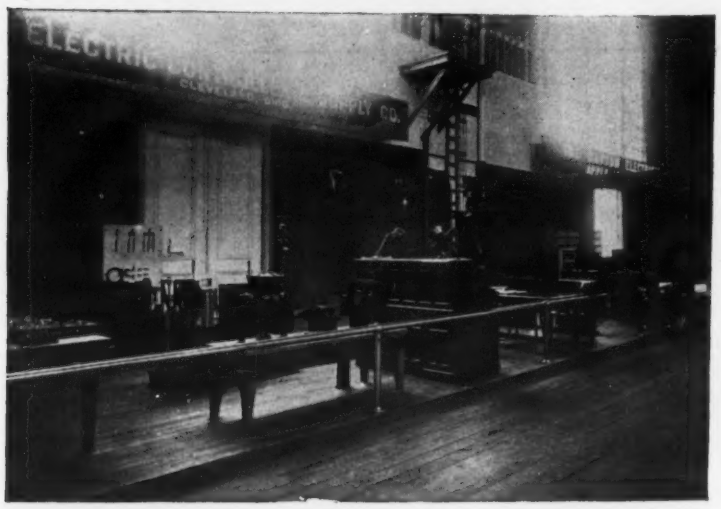


FIG. 4.—EXHIBIT OF ELECTRIC CONTROLLER & SUPPLY COMPANY.

on a 36-in. planer, which is driven through one pinion and gear of a 6-hp variable-speed motor. The motor being direct-connected, is reversed at each end of each stroke of the planer. The motor is compound wound, but the series field is only used for acceleration and is short-circuited when the motor comes to speed. The speed of the cut and return may be varied independently and through a very wide range. This planer is shown in actual operation cutting iron and steel, so that a complete demonstration is given. The advantages claimed for this controller are as follows: It absolutely limits the maximum current which may flow to the motor, thus protecting the motor, gearing and machinery from the effects of abnormal torque; the protection of the motor and machinery does not depend upon the judgment of the operator; the controller protects the motor perfectly in case the voltage of circuit fails. Even if the controller be left in the "full on" position, when the circuit is re-established, the controller will automatically start the motor with the normal amount of current; the operating controller is small and compact, easy of operation and protected from arcing.

A three-ton lifting magnet attached to a hoist is shown lifting steel plates and billets. Magnetic friction brakes and a cushion type

FIG. 5.—BOOTH OF AUTOMATIC ELECTRIC COMPANY.

solenoid are exhibited and in operation. The remainder of the space is filled with a line of controllers for all purposes, crane supplies, resistance units and a magnet for handling pig iron. Another operating exhibit is made by the company in connection with the Niles Tool Company in Machinery Hall, where a 90-hp electric reversing clutch operates a 12-ft. planer. This is the largest planer ever built and its operation by belts would be impossible.

The Automatic Electric Company's exhibit of telephone apparatus is attracting general attention on account of the time and trouble-saving features of the automatic system. This exhibit includes two complete working automatic exchanges of the 10,000 type, each with

FIG. 6.—EXHIBIT OF AUTOMATIC ELECTRIC COMPANY.

100 stations installed. These two exchanges, which are now giving service throughout the Electricity Building, are connected together by a system of trunks, similar to that generally used to connect branch exchanges to each other. The selection of trunks, however, is done automatically. The automatic system requires the use of no name prefixes, and the subscriber need not be aware that he is calling through more than one exchange, since the directory contains only numerical designations. In all cases three or four rota-

tions of the calling dial will secure instantaneous and direct communication with the telephone desired. The telephones exhibited are of three types, the wall, the desk and the pedestal. All of these telephones are fitted with the regulation calling dial, a circular metal piece, on whose periphera are ten finger holes numbered from 1 to 10. This dial is fixed on an axis at its center, and as the finger is placed consecutively in the hole corresponding to the digits of the number desired, and the dial turned once for each digit, electrical impulses are conveyed to the switches at the central office setting them in operation and bringing through them the proper connections.

A tollboard of ten stations is also in service, demonstrating the manner in which toll connections are given to users of automatic telephones. The rest of the apparatus displayed is of the same general character as that which may be seen in connection with any up-to-date telephone exchange, save the "tell-tale" board. This is simply a device for the instantaneous location of trouble, wherever it may arise, and consists of a number of lamps on a slate slab, together with a magneto bell. In case of trouble, this magneto bell rings calling the attention of the attendant, and a lamp glows, by the position of which on the board the location of the trouble can be instantaneously ascertained, and promptly rectified. The photograph shows the artistic booth which is elegantly furnished.

The exhibit of the Holophane Glass Company is one of the most striking in the building and is lighted by over 1,000 incandescent lamps. The booth is in the form of a Grecian temple, fronting on three aisles in Section 25. It has a frontage of 77 ft. on the main aisle and 31 ft. on each side aisle. Over the central doorway electric lights covered with Holophane globes form the word "Lux" in white letters and on each side is suspended a large Holophane 16-in. ball, hanging by three chains. On the door casings are torch brackets surmounted by pillars topped with Holophane globes, containing three colored lamps. These are suitably connected to a Reynolds flasher, so that a beautiful change of colors will occur at different intervals. Between these posts are plate glass cases containing samples of the different kinds of prismatic globes and reflectors manufactured by this company. The entrances from the side aisles are through two Grecian porches, the ceilings of which are studded with electric lights in different colors.

The center room of the interior is divided in two portions, showing two dining-rooms, which will be fitted identically, as far as furnishings and fixtures are concerned, but in one case Holophane globes will be used and in the other ordinary globes, so that a person can see at a glance, by looking at the two rooms, the difference in illumination. On each side of this room there is another apartment, suitably divided to show 12 dark rooms, in which there will be an opportunity to compare the different forms of Holophane globes and Pagoda

FIG. 7.—HOLOPHANE EXHIBIT.

reflectors with other kinds of globes and reflectors. The ceilings and walls are all of paneled oak and in the center of the main room is a $2,000 fireplace. The roof of the building will be used by the company for the entertainment of its guests and its offices. On each side of the main entrance are the two words, "Holophane" and "Pagoda" in 18-in. letters made of Holophane globes and will present an ever varying change in color scheme. First the words will appear in red letters, then in green, then in purple; then in red and green, red and purple, green and purple, and finally in red, green and purple. The exhibit is a joint one between the Holophane Glass Company, the Illuminating Appliance Company and the V. R. Lansingh Company.

A notable feature in the booth of the Heinze Electric Company is an induction coil capable of giving a 40-in. spark. Smaller coils for 30, 20 and 12-in. spark machines are also operating. A new

FIG. 8.—BOOTH OF HEINZE ELECTRIC COMPANY.

form of mechanical interrupter giving a maximum secondary discharge with a minimum primary current is especially adaptable for X-ray apparatus. There are a number of tubes capable of carrying heavy discharges necessary to make instantaneous radiographs, some of which have been taken in a fraction of a second.

In the Court of the Electricity Building, the Missouri Electra Water Purifier Company is exhibiting the Kune process of purifying water by electricity for commercial purposes. The electric purifier has a capacity of 500 gallons of purified water per day, the power consumption being 30 amp. at 15 volts. The apparatus consists of a purifier, generator, switchboard, a precipitating tank and

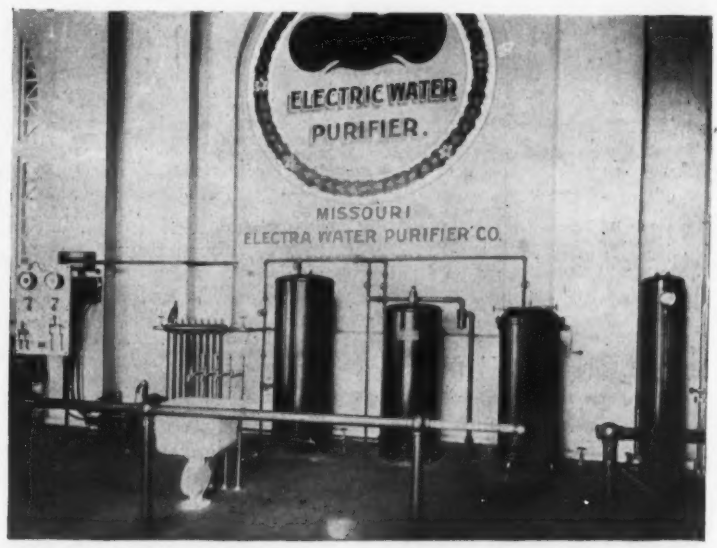


FIG. 9.—MISSOURI ELECTRA WATER PURIFIER.

a filter. The electric current destroys the bacteria and organic matter, also reduces the salts of lime, sodium, magnesium and the like, and any soluble salts of metallic compounds are eliminated. The electrolytic action of the anode produces an insoluble hydrate which acts as a coagulation gathering the released impurities together in an insoluble mass and precipitating them, so that when the water has passed through the strainer or filter, it is free from the impurities. Another interesting feature is a collection of samples of water from the principal cities of the United States, before and after being subjected to this treatment.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Business on the Stock Exchange was somewhat larger, although it was mainly of a professional character, a few stocks, notably Southern Pacific, constituting the bulk of trading. The favorable character of crop reports had a buoyant effect on the market. The standard stocks seemed to have fair support and there was a more or less buying movement in Manhattan Elevated. The other traction stocks, however, were neglected in spite of continued talk about the improvement in Brooklyn Rapid Transit earnings. On Friday Metropolitan Street Railway and Third Avenue developed exceptional weakness on the report that the Metropolitan Street Railway Company would not pay the first quarterly dividend of 1¼ per cent. on Third Avenue stock, under the terms of the lease of that road. The industrial list was neglected, apart from the firm tone of Steel preferred, which was due to the anxiety of the short interest in the latter owing to the continued intimations that the earnings for the June quarter may be as large as $18,000,000, and that the maintenance of the preferred dividend may be depended upon. In the traction list, Brooklyn Rapid Transit lost ¼ point and Metropolitan Street Railway 2⅜ points on the week's business. The former closed at 48⅛ and the latter at 111½, which was also the lowest quotation of the week. There was considerable trading in Metropolitan, the sales aggregating 50,600 shares. General Electric closed at 152¼, ex-rights, this being a net gain of 1¼ points over the last previous quotation. General Electric rights were sold at 5, which was also the closing figure. Westinghouse was steady throughout the week at 156. Western Union was quiet and unchanged at 87½, while American Telephone & Telegraph closed at the highest point, namely, 129¼, this being a net gain of 1¼ points. The curb market was generally reactionary following the trend of the exchange. There was a further sharp rise in Interborough Rapid Transit stock to a new high record. Following are the closing quotations of June 21:

NEW YORK

	June 14	June 21		June 14	June 21
Allis-Chalmers Co.	7⅛	8	Electric Vehicle	8¼	9¼
Allis-Chalmers Co. pfd.	41	42	Electric Vehicle pfd.	11	12
American Tel. & Cable	87	87	General Electric	158⅛	151
American Tel. & Tel	128¾	130	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	114½	110⅜
Brooklyn Rapid Transit	48⅝	48¾	N. Y. & N. J Tel.	..	..
Commercial Cable	175	175	Marconi Tel.	..	..
Electric Boat	30	32	Western Union Tel.	87	86⅛
Electric Boat pfd.	64	65	Westinghouse com.	154	155¾
Electric Lead Reduction	*⅝	*⅝	Westinghouse pfd	180	175

BOSTON

	June 14	June 21		June 14	June 21
American Tel. & Tel.	128¾	130⅛	Western Tel. & Tel. pfd.	80	80
Cumberland Telephone	112	114¼	Mexican Telephone	1¼	1⅛
Edison Elec. Illum.	234¾	234	New England Telephone	120	119
General Electric	156	..	Mass. Elec. Ry	18¼	18
Western Tel. & Tel.	7⅛	8	Mass. Elec Ry. pfd.	70	70¼

PHILADELPHIA.

	June 14	June 21		June 14	June 21
American Railways	43	44⅛	Phila. Traction	..	96¼
Elec. Storage Battery	54	54	Phila. Electric	6	6
Elec. Storage Battery pfd.	54	54	Phila. Rapid Trans.	12	11¾
Elec. Co. of America	8⅛	8⅛			

CHICAGO

	June 14	June 21		June 14	June 21
Central Union Tel.	..	..	National Carbon pfd.	*102	100
Chicago Edison	..	142	Metropolitan Elev. com.	20¾	18¼
Chicago City Ry.	175	*175	Union Traction	..	5
Chicago Tel. Co.	..	120	Union Traction pfd.	*30	27
National Carbon	26¼	26¼			

*Asked

DIVIDENDS.—The directors of the American Telephone & Telegraph Co. have declared the regular quarterly dividend of 1½ per cent. and an extra dividend of ¾ per cent., payable July 15. Otis Elevator directors have declared the regular quarterly dividend 1½ per cent. on the preferred stock, payable July 15. The directors of Detroit United Railway have declared the regular quarterly dividend of 1 per cent. on the capital stock, payable Aug. 1. New York Air Brake directors have declared the regular quarterly dividend of 2 per cent. The dividend is payable July 15. The Mackay companies have declared a regular quarterly dividend of 1 per cent. on the preferred stock, payable July 9. The Southern New England Telephone Co. has declared a quarterly dividend of 1½ per cent., payable July 16 to stockholders of record June 30. It is expected that the announcement of the terms of the new stock will be given out in July. The International Steam Pump Company has declared the regular quarterly dividends of 1½ per cent. on the preferred and 1 per cent. on the common. The regular quarterly dividend of 1¾ per cent. on Metropolitan Street Railway is payable July 15. The Cincinnati Gas & Electric Company's directors have declared a quarterly dividend of 1⅛ per cent., payable July 1. This is an increase of ⅛ per cent. Union Traction of Indiana directors have declared a dividend of 1 per cent. on the common stock, payable July 1. Directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable July 1.

ROCHESTER (N. Y.) CONSOLIDATION.—The Rochester Railway Gas & Electric merger is regarded as virtually assured. More than 20,000 out of a total 25,000 shares of Rochester Railway common stock has been deposited in assent to the plan, and one of the lighting companies has ratified the agreement. Threatened litigation on the part of a rather large preferred stockholder in one of the latter companies is not expected to interfere with the consummation of the plan. The combining companies are reported to be earning the equivalent of at least 5 per cent on the preferred stock of the new company, the stock being entitled to 4 per cent. per annum the first two years. The receipts for the new common stock, $20 paid, are quoted at about 37 to 39. Rochester Railway common receives 120 per cent. in the new Rochester Railway Gas & Electric preferred.

BROOKLYN RAPID TRANSIT BONDS.—The Brooklyn Rapid Transit has sold $3,000,000 of its 4 per cent. bonds at about 79½. Of the total amount $1,000,000 each was taken by an insurance company and a trust company. The bonds are a part of the authorized issue of $150,000,000, of which only $5,000,000 has been issued so far.

BOSTON TROLLEYS.—The Boston Suburban Electric Companies are issuing new stock at $66.67 per block of one share of preferred and one of common. Stockholders can subscribe at the rate of one block for every four shares held. The issue is to consist of 15,848 additional preferred shares and 15,848 common.

VIRGINIA TROLLEYS.—Richmond (Va.) dispatches state that the Chesapeake Transit Company has applied to the Corporation Commission for authority to increase its capital to $1,500,000 from $1,000,000. The company operates an electric road from Norfolk to Virginia Beach.

THE NIAGARA, LOCKPORT & ONTARIO POWER COMPANY has voted to increase its capital stock from $1,000,000 to $10,000,000 to construct the canal from the Niagara River, under a State charter granted ten years ago.

MANHATTAN FIRE ALARM.—At a special meeting of the stockholders of the Manhattan Fire Alarm Company, held recently, the proposition to increase the capital stock from $500,000 to $700,000 was adopted.

Commercial Intelligence.

THE WEEK IN TRADE.—Conditions have been more favorable, among the features being a further improvement in leading crops and the ending of the tie-up on the lakes. General trade and industry still remain quiet. The notable underlying feature of the entire situation is the feeling that with an average crop of wheat and large yields of other cereals and cotton now in prospect, a good fall and winter business may be looked for. Prices of leading products have felt the influence of crop news, wheat, oats and cotton declining, while corn has remained steady on reports of backward conditions and small supplies offered. Railway earnings reflect current quietness in business, transportation business in general, however, being better than in 1902. Bank clearings show an enlargement over the week previous, but the grand totals are less than those of a year ago. Collections still reflect the influence of a backward spring in retail trade and are complained of as slow at a number of centers. Quietness prevails in the leading industries, iron and steel being dull and production curtailed. Prices, however, are a little firmer. Demand for structural material is inactive. The lumber trade is rather irregular, being much depressed on the Pacific coast, fairly active in the Northwest, but rather dull in the East. Dispatches to *Bradstreet's* from leading centers indicate a moderate business and conservative buying, not in all cases, however, equal to last year. The copper market was lower, weak and uninteresting. Prices are: Lake, 12⅝ @ 12¾; electrolytic, 12⅜ @ 12⅝; casting stock, 12⅛ @ 12¼. The exports continue on a large scale. There were 181 business failures during the week ending June 16, according to *Bradstreet's*, against 171 the week previous and 165 the corresponding week last year.

EXPORTS OF MACHINERY.—An interesting statement has just been issued by the Bureau of Statistics at Washington showing the rapid increase in exports of machine tools and allied apparatus. Exports of agricultural implements from the United States in the fiscal year about to end will amount to about $25,000,000 in value. This is an increase of about $4,000,000 over last year and about $9,000,000 over the preceding year. In no class of manufactures exported has the growth been more steady and persistent than in that of agricultural implements. Comparing the growth in exports of agricultural implements with that in other articles during the same period, it may be said that cars and carriages have increased from $3,333,000 in 1894 to a probable $12,000,000 in 1904; chemicals, from nearly $7,500,000 in 1894 to a probable $14,500,000 in 1904; scientific instruments, from $1,500,000 in 1894 to $8,000,000 in 1904; and manufactures of leather, from $14,000,000 in 1894 to approximately $33,000,000 in 1904, while agricultural implements have increased from $5,000,000 in 1894 to a probable $25,000,000 in 1904. A table prepared by the Department of Commerce and Labor shows that of the $19,000,000 worth of agricultural implements exported from the United States during the 10 months for which detailed figures are available, nearly $10,000,000 went to Europe, $4,000,000 to South America, $3,000,000 to North America, $1,500,000 to Asia and Oceania, and a little over half a million dollars' worth to Africa. The values of the exports of agricultural implements for the years 1897 to 1904, inclusive (May and June of this year being estimated), are as follows: 1897, $5,240,686; 1898, $7,609,632; 1899, $12,432,197; 1900, $16,099,149; 1901, $16,313,434; 1902, $16,286,740; 1903, $21,006,622; 1904, $25,000,000.

ORDERS FOR TELEPHONE APPARATUS.—The Attica Telephone Company, of Attica, Ind., has recently placed with Frank B. Cook, of 239 West Lake Street, Chicago, an order for his type L iron frame distributing rack, to be equipped with his protectors having the self-soldering heat coil. The distributing frame is equipped for 600 pairs, and the telephone company has recently discarded its old protective system. Among the other Indiana exchanges, which have recently been equipped with Cook's apparatus are Worthington (which has the same style of frame with a capacity of 400 pairs), South Bend, Fort Wayne, Bedford, Franklin, Garrett, Brookston, Frankfort and La Fontaine. Mr. Cook has also completed the shipment of a large distributing frame for the automatic exchange of the Home Telephone Company, of Los Angeles, Cal. This is what Mr. Cook styles his "No. 444," with self-soldering heat coils, and the frame is equipped for 4,875 pairs. He previously equipped the manual exchange of the Home Telephone Company with a frame having a capacity of over 10,000 pairs, and using Cook's well-known "No. 4" protectors. Mr. Cook has also recently filled large orders for his protective devices from the Pittsburg & Alleghany Telephone Company, and from the Kellogg Switchboard & Supply Company, for their Louisiana Purchase Exposition exchange. A large order has also been received from Rome, Italy, showing that the apparatus is well known in foreign countries as well as in the United States.

FLOATING INDUSTRIAL EXHIBITION.—The Northwestern Commercial Company, of Seattle, Wash., is to dispatch the S. S. "Victoria" from that city on November 15, to carry a floating industrial exhibition to visit the cities of Yokohama, Kobe, Nagasakai (Port Arthur and Vladivostock, if war conditions permit), Shanghai Hong Kong, Manila, Singapore, Colombo, Mauritius, Delago Bay (Johannesburg and Pretoria), Cape Town, Adelaide, Melbourne, Sydney and Honolulu. The "Victoria" is large, commodious and fast. She was purchased from the Northern Pacific Railroad Company and her first-class passenger accomodations have been renewed at an expense of about $100,000. The vessel has accommodations for 226 first-class passengers, but the number on this exhibition tour will be limited to 100 actual exhibitors, with the opportunity of 50 of them to take their wives, making a total maximum number of 150. The lower decks of the vessel, ordinarily used for second and third-class passengers, will be arranged in the most convenient manner for exhibition purposes. These decks are large and spacious, and will be divided among the exhibitors. They will be decorated and brilliantly lighted by electricity, and while the vessel is in port the exhibition space will be open to the general public from 8 a. m. to 11 p. m. Steam or electric power will be furnished to any exhibitor requiring same. The scheme is not altogether new and will remind some electrical people of the "Great White Special" of a few years ago.

MAY EXPORTS AND IMPORTS.—The statement of imports and exports of merchandise, gold and silver for May and for eleven months ending May is notable as showing that imports of merchandise are, in a measure, stationary, while the exports of merchandise show rather large fluctuations. This fact is borne out by a comparison with May in 1903, the merchandise imports for the month being about $1,000,000 more than in May, 1904, while merchandise exports decreased about $11,000,000. The excess exports of merchandise for May were the smallest since August, 1903, due in a large measure to the falling off in the demand for American wheat and cotton, the exports of which were greatly restricted by high prices prevailing here. For the eleven months ending May the exports of merchandise are the largest on record, with the exception of 1901, and the imports for the eleven months are the largest on record with the exception of the same period in 1903. From present indications the excess exports for the current fiscal year which ends June 30 will be in the neighborhood of $470,000,000, which would compare with $349,372,000 in 1903, $478,398,000 in 1902, and $664,592,000 in 1901.

1,500 MILES OF COPPER CABLE.—The Mexican Light & Power Company, whose New York offices are at 129 Broadway, has placed a contract for copper cable which is claimed to be the largest ever awarded. The contract calls for no less than 1,500 miles of cable, equal in carrying capacity to 3/0 B. &. S. gauge and weighing nearly 2,000 tons. The cable is to be utilized on the power transmission line now under construction by the company between its power plant at Necaxa, which is to have an initial capacity of 45,000 hp and an ultimate development of 80,000 hp, to Mexico City and from there on to El Oro mining district. It will be supported on steel towers in spans of 500 ft. The length of the spans, together with the necessity of reducing the dip as much as possible and the high wind pressure to be withstood make the matter of cables one of considerable importance. The cable was designed by Mr. W. G. Clark, the electrical engineering expert of Seattle, Wash. The Ansonia (Conn.) Brass & Copper Company has been allotted the contract.

EQUIPMENT FOR APARTMENT HOTEL.—A 12-story apartment hotel is to be built at Eighty-ninth Street and Central Park West, New York, which will be installed with an electrical plant. Mr. Peter Banner, of 648 Broadway, is to be the owner; Mr. Robert T. Lyons is the architect. Mr. Percival Robert Moses, 35 Nassau Street, has been retained as consulting engineer. There will be three horizontal return tubular boilers of 150-hp capacity each. The engines will be three simple automatic high speed horizontal type. Two will be 14 in. x 14 in. while one will be a 13 in. x 12 in. They will operate at from 275-300 r.p.m. The generators will be direct current, compound wound multipolar, 240 volts. There will also be an extensive storage battery system.

NERNST LAMP ORDERS.—That the Nernst lamp is rapidly coming into favor in the city of Chicago, is evidenced by the fact that many of the company's customers are placing orders to increase the size of their Nernst lamp installations. Among these are Armour & Co., also Nelson & Morris at the Union Stock Yards. The former company has recently added six 6-glower and nine 3-glower Nernst lamps to its system, while Nelson & Morris have increased their already large installation with twelve 3-glowers. In this connection it may be mentioned that Swift & Co. in the same locality have 125 6-glower and 750 3-glower Nernst lamps in satisfactory operation.

HEINE BOILER ORDERS.—The Heine Safety Boiler Company has secured a contract for a 500-hp outfit to be installed in the additional plant to be constructed by the Quincy (Ill.) Gas & Electric Co. The Edison Illuminating Co., of Pottsville, Pa., is also about to extend its plant, and will put in a 250-hp boiler equipment. Two 250-hp Heine boilers are to be installed in the electric power plant at the new Wabash passenger station at Pittsburg. The Marysville (O.) Water & Light Co. has ordered a 300-hp outfit for its plant.

GENERATORS FOR WAR DEPARTMENT.—The Ridgway Dynamo & Engine Company, Ridgway, Pa., has just been awarded a contract for four 75-kw direct-connected generating sets by the War Department, through the Major of Engineers at Seattle, Wash. These sets are for lighting and power purposes at various Pacific coast army posts and are to be delivered immediately.

G. E. MOTOR EQUIPMENT FOR JAPAN.—Eight hundred G. E. 54 motor equipments will be used in the cars for the Tokio Street Railway Company, which concern is building some 30 miles of electric traction system in Tokio, Japan. The power house equipment will be of 7,000-kw capacity and will be the largest electrical plant in the Far East. Curtis turbines will be installed.

EQUIPMENT FOR NEW OFFICE BUILDING.—Orders are about to be let by the Geo. A. Fuller Company, New York, for the electrical equipment to be installed in the new office building under construction at 78 Wall and 158 Pearl Streets for the Taber Company. There will be two 12-in. x 11-in. engines direct-connected to 50-kw generators.

THE WATERTOWN STEAM ENGINE COMPANY is now installing a 400-hp compound condensing engine in Catskill, N. Y. It has just shipped three engines aggregating 600 hp to Trinidad, Col., and is now building a fourth to develop 1,000 hp arranged for direct connection to a 600-kw General Electric generator.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—The Phoenix Independent Telephone Company which has just been organized is now soliciting business in this city, and is endeavoring to get 500 subscribers. It is stated that the initial expenditure for installation will be about $50,000.

LOS ANGELES, CAL.—The Pacific Coast Telephone Construction Company, of Los Angeles, has been incorporated with a capital stock of $25,000. The directors are Charles F. Guthridge, Charles L. Zahn, Arthur Wright, and others.

DAHLGREN, ILL.—The Dahlgren People's Telephone Company has increased its capital stock from $5000 to $10,000.

SHELBYVILLE, ILL.—The Duvall Mutual Telephone Company has been incorporated with a capital stock of $420. The directors are C. E. Kreig and others.

SUMMITVILLE, IND.—The Boone Township Telephone Company has incorporated with a capital stock of $1000.

PORTLAND, IND.—The Farmers' Co-operative Telephone Company of Jay County has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. W. H. Harkins, Suphus Straley, E. W. Polly and others are the incorporators.

ST. JOHN, KAN.—The Albany Telephone Company has been incorporated with a capital stock of $840.

BARNARD, KAN.—The Barnard Telephone Company has been incorporated with a capital stock of $5000.

DELPHOS, KAN.—The Rural Telephone Company has been incorporated with a capital stock of $3400.

HOXIE, KAN.—The Sheridan Telephone Company has been incorporated with a capital stock of $2000.

MAHASKA, KAN.—The Mahaska Telephone Association has been incorporated with a capital stock of $3500.

CHAPMAN, KAN.—The Chapman Mutual Telephone Company has been incorporated with a capital stock of $5000.

EUREKA, KAN.—The Greenwood County Telephone Company has been incorporated with a capital stock of $33,000.

LOUISVILLE, KY.—The London and East Bernstadt telephone companies, connecting Clay and Laurel counties, have been consolidated, with a capital stock of $14,000.

BREAUX BRIDGE, LA.—There is a movement on foot in this town to organize an independent telephone company. It is proposed to operate an exchange here and build toll lines to St. Martinville, and other points in the parish.

CASCO, ME.—The Casco Telephone Company has been organized with a capital stock of $10,000. The officers are: President, Richard Cook; treasurer, Herman L. Cook.

WATERTOWN, MINN.—The Watertown Telephone Company has filed articles of incorporation, the capital being $25,000. The officers are: President, F. A. Barth; vice-president, G. F. Peterson; secretary, G. E. Halgren; treasurer, R. J. Burke.

SENECA, MO.—The Seneca Telephone Company has applied to the city for an extension of its franchise for 20 years.

LINCOLN, NEB.—The Western Telephone Company has been incorporated with an authorized capital stock of $1,000,000. The incorporators are Charles J. Bills, Mark Woods, George J. Woods, Frank H. Woods and Thomas H. Ewing. The company intends to construct long-distance lines to make connections with the independent system in Lincoln. One line has been constructed already, the wires running from Lincoln to Havelock, and there connecting with the Plattsmouth Company that has run its wires to this town. Five other long distance lines are projected. One is to Nebraska City; another taps the southeast section of the State and runs generally in the direction of Falls City; a third will run for the business of Saline and Fillmore counties; the fourth will be in the direction of York, and the last will run to Davey, where the Golden Rod system is already installed.

TRENTON, N. J.—The system of the Interstate Telephone Company between this city and Atlantic City has been completed, and direct telephone communication between the two points is now possible. The line goes to Atlantic City by way of Philadelphia.

ALBANY, N. Y.—The extension of the Rensselaer County Telephone Company's system through the city of Rensselaer is one of the future probabilities. Application for a franchise is now being made. The company will have connection with the Home Telephone companies of Albany and Schenectady.

CATSKILL, N. Y.—The telephone war in this village, which was noted last week, has been brought to a close, the West Shore Company agreeing to raise its wires and thus avoid lengthy litigation if it persisted in obstructing the construction of the lines belonging to the Hudson River Company.

ELIZABETH CITY, N. C.—A company has been organized to construct a telephone line from this place to Weeksville, a distance of 16 miles. Contracts for the construction work have been awarded.

MARSHFIELD, ORE.—E. C. Drew and Ed Riggs propose to establish a telephone system here.

WELLSTON, OHIO.—The Wellston Mineral & Athens Telephone Company has increased its capital stock from $2000 to $10,000.

WESTMINSTER, OHIO.—The United Farmers' Telephone Company, of Westminster, has increased its capital stock from $10,000 to $20,000.

CLEVELAND, OHIO.—The United States Telephone Company, it is stated, is about to begin construction work, the wire alone for which will cost $160,000. This work will include the new line between Dayton, O., and Richmond, Ind., which will give long distance connections through Indianapolis and St. Louis to Kansas City. Lines will be strung into Cincinnati and Wheeling, W. Va.

CHARLESTON, S. C.—A commission has been issued to the Coast Line Telephone Company, of Charleston, which will establish a telephone system on the coast islands. The capital stock is placed at $15,000, and the petitioners are: C. B. Jenkins, F. W. Towles and Julian Mitchell, Jr.

HAMMONDSPORT, S. C.—The several rural telephone lines centering in Hammondsport have formed an association known as the Hammondsport Rural Telephone Association. The following officers have been elected: Robert Sherer, president, and Maurice A. Hoyt, manager.

AUSTIN, TEX.—The Bay City & Matagorda Telephone Company, of Bay City, has been incorporated with a capital stock of $5000. The names of the incorporators are W. W. Boulden, R. H. Taylor, of Bay City, and A. W. McNab, of Matagorda.

DENISON, TEX.—The Grayson County Telephone Company will make improvements to its system between Denison and Sherman at a cost of $50,000. Fifty thousand feet of cable will be purchased and the equipment will be renewed and improved wherever necessary.

GALVESTON, TEX.—It is stated that H. E. Huntington has absorbed twenty-three additional independent telephone systems and leased lines in Texas, Arkansas, Indian Territory, Louisiana and Oklahoma, many of them being located in prominent cities, including Galveston, Houston, Dallas, Fort Worth, San Antonio, South McAlester, Little Rock and Oklahoma City, Okla. It is understood that Mr. Huntington and his associates have set aside $10,000,000 with which to organize a rival company to the Southwestern Telephone & Telegraph Company. It is also learned upon good authority that the Southwestern consolidation is but a nucleus with which to initiate a telephone organization that will give local and long-distance service throughout the United States.

EVERETT, WASH.—The Tualco Telephone Company has been incorporated with a capital stock of $1000. The names of the incorporators are F. E. Ferguson, F. E. Phelps and T. W. Bennett.

RACINE, WIS.—The Citizens' Telephone Company has purchased a site in this city on which it will erect a new telephone exchange. The company was organized three years ago and now has 2000 subscribers.

HONOLULU, HAWAII.—A quasi-government system of telephone has just been completed on the island of Molokai and is worked in connection with the wireless telegraph system of the Hawaiian Islands, and through that with the Pacific cable. The system is a sort of communal one, the people themselves agreeing to maintain and keep in repair the portion of the line in their respective districts.

ELECTRIC LIGHT AND POWER.

LUVERNE, ALA.—It is proposed to construct water works and an electric light plant at a cost of $10,000. No engineer has been selected as yet. Bids will be received after July 1. A. B. Brooks is city clerk.

NASHVILLE, ARK.—It was voted June 2 to construct water works and an electric light plant.

OXNARD, CAL.—The Oxnard Light & Power Company is having plans prepared for an electric power house and plant.

NORFOLK, CONN.—J. H. Roraback, of Canaan, is interested in the construction of an electric light plant on Mill River to furnish power to Canaan and Norfolk.

HARTFORD, CONN.—The Hartford Electric Light Company, Hartford, Conn., has bought a tract of land and will erect a power plant to take the place of its present Pearl Street plant. The company's Westinghouse-Parsons turbine will be removed to the new plant, and it is understood that it will install another turbine set of the same type, as well as increase its boiler capacity.

MONTICELLO, FLA.—The electric lighting plant, owned by J. M. Henry, of this town, was destroyed by fire some time ago and has not been rebuilt. The town is greatly in need of a plant and the erection of a new one is now in contemplation.

ALBANY, GA.—It was voted June 9 to issue $10,000 bonds for improvements to the water works and electric light plant.

WOODHULL, ILL.—The Woodhull Electric Light Company proposes installing a new dynamo and will be in the market for the same.

INDIANAPOLIS, IND.—H. C. Hendrickson is preparing plans for a brick power-house for the Martinsville Light & Power Company.

ELKHART, IND.—The Elkhart City Electric Company has been incorporated, with a capital of $50,000. Incorporators: C. G. Conn, P. L. Turner and W. J. Gronert.

OXFORD, IND.—The managers of the municipal electric lighting plant here are figuring on lighting two other small towns at a distance of 5 and 8 miles. Current will be transmitted at a voltage of 6600 to the most distant town and step-up transformers will be required.

BOONE, IA.—It is stated that the Council will take up the matter of an electric light plant for the city at once.

AFTON, IA.—It is proposed to give the municipal electric lighting plant in this place a general and complete overhauling.

LOUISVILLE, KY.—The American Electric Lighting Company, of Oakdale, has filed articles of incorporation, the capital stock being fixed at $10,000. The incorporators are Charles A. Hess, Mary Rosenfield, Louis F. Otto and Thomas Flordon.

BANGOR, ME.—The Underwriters' Light, Heat & Power Company has been organized at Bangor, with $3,000,000 capital stock. E. T. Nealey, of Bangor, is president, and Frank L. Goodwin, treasurer.

BALTIMORE, MD.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., June 27, for the installation of an elevator plant and electric house pumps at the U. S. Post Office, Baltimore.

BOSTON, MASS.—Sealed proposals for boilers, engines, generators, cables and conduit for electric light and power plants will be received at the office of the United States Engineer, in this city, until July 11. Information can be obtained on application to W. S. Stanton, Lieut. Col. of Engineers.

KALAMAZOO, MICH.—The Council has under consideration the matter of issuing $18,000 bonds for improving the electric plant.

ROYALTON, MINN.—Plans and estimates are being prepared for a municipal lighting system, and the matter will be submitted to a vote of the people.

CHISHOLM, MINN.—The Chisholm Light & Power Company has filed articles of incorporation, the capital stock being $20,000. The incorporators are Nils Anderson, of Virginia, Henry A. Liedel and Daniel D. Crowley, of this city. Duluth will be the principal place of business.

BOONEVILLE, MISS.—Business men of this place have organized a company to establish an electric light plant and telephone system. A franchise has been granted and application for a charter for the new company will now be made. Contracts for the building will be let.

HOBOKEN, N. J.—After a lively meeting of the city council a few evenings ago the contract for street lighting was awarded to the United Electric Company at $100 per light per year. A joint committee from the Taxpayers' Association and the Hoboken Innkeepers' Association urged the mayor to withold his signature and veto the contract, asserting that they could produce independent bidders if the bids were readvertised for and guaranteeing to make a much lower bid than $100 per light. As the committee refused to divulge any of the names of these proposed bidders, the mayor announced that he would sign the contract.

NORTH ELBA, N. Y.—The Ausable Valley Light, Heat & Power Company, of North Elba, has been incorporated with a capital stock of $30,000. The directors are Wallace Murray, P. A. Gould, A. K. Botsford, of Saranac Lake.

SAG HARBOR, L. I., N. Y.—A proposal to construct an electric light system and issue bonds in the sum of $24,000 to pay for the same was defeated at a special corporation meeting on June 9. This is the third time that the question has been before the people.

ROCHESTER, N. Y.—Papers were filed in two suits on June 10, to prevent the projected merger of the Rochester Gas & Electric Company, the Rochester Railway Company and the Rochester Light & Power Company. The plaintiffs in each case are minority stockholders in the Rochester Gas & Electric Company. The complainants claim that the proposed merger is unlawful and against public policy. At a meeting of the stockholders of the Rochester Gas & Electric Company the proposition to consolidate with the Rochester Light & Power Company was ratified.

LEXINGTON, N. C.—It was voted June 7 to issue $60,000 bonds for the construction of water works and an electric light plant. J. L. Peacock is City Clerk.

WILSON, N. C.—The Wilson Light & Power Company, of Wilson, has been incorporated, with a capital of $125,000, by J. C. Hales, B. T. Lane, Claudius Aycock, and others.

SALEM, OHIO.—The Salem Light & Power Company has been incorporated with a capital of $10,000, by J. S. Khinefelter, J. G. Wilson, C. M. Wilson, and others.

MASSILLON, OHIO.—Bids will be received July 9 by the Board of Trustees of Massillon State Hospital at the office of F. L. Packard, architect, Columbus, for furnishing and erecting in the power-house at said hospital a 450-hp engine, two 350-hp boilers, one 300-kw generator and a switchboard. Address H. C. Eyman, M. D., secretary.

READING, PA.—A bill calling for a special election to obtain the assent of voters for a $200,000 loan for a municipal electric light plant was defeated in the Select Council.

MAHANOY CITY, PA.—Application has been made by Harrison Ball and John I. Mathias, of Mahanoy City; T. D. Jones, of Hazleton, and others, for a charter for the Economy Light, Heat & Power Company.

CHATTANOOGA, TENN.—The City Council has agreed to issue $1,000,000 bonds for the purpose of constructing an electric light plant to be operated by water power. The plant will be erected and controlled by private parties, who will pay the city 5 per cent. for the use of the capital to be derived from floating the bonds, upon which the city will pay interest. The city reserves the right to purchase the plant at the expiration of 50 years, and during the existence of the contract is given 500 free lights.

SHERMAN, TEX.—The Sherman Gas & Electric Company has been incorporated with a capital of $200,000. J. F. Strickland, Dallas, is one of the incorporators.

EL PASO, TEX.—The Mimbres River Water Company has been incorporated for the purpose of carrying on the business of a water company, and construct electric light and power plants for supplying electric lights and power for domestic and public uses in the city of El Paso and other communities: capital, $2,000,000. The principal place of business is Albuquerque, N. M. Incorporators: Geo. W. Delamater and Jas. S. Delamater, of Pittsburg, Pa.; Allan G. Kennedy, of Santa Fe, N. M. and Edw. L. Medler, of Albuquerque, N. M.

BRANDON, VT.—At the annual meeting of the Neshobe Electric Light Company, which was held here recently the directors elected officers as follows: President, Dr. O. C. Baker; vice-president, Charles Dewey; treasurer, George H. McLeod.

SNOHOMISH, WASH.—The plant of the Cascade Cedar Company was completely destroyed by fire, the loss being $6000. The company has secured temporary equipment pending the rebuilding of the plant.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—San Francisco and San Jose capitalists have been granted a franchise by Secretary of the Interior Hitchcock to build an electric railway into the Yosemite National Park. This is the first franchise ever granted by the Government for an electric railway into any Government reservation. Stations are to be constructed every 10 miles.

AUGUSTA, GA.—The stockholders of the Augusta & Elberton Railroad have authorized an issue of first mortgage gold 6 per cent. bonds, $10,000 per mile, or a total issue of $750,000. Fred T. Lockhart, secretary and treasurer of the company, says the construction of the line will now soon begin.

MONTPELIER, IND.—The Portland, Montpelier, Warren & Huntington Traction Company has organized by electing the following-named officers: James West, president and general manager; Scott Mills, vice-president; D. A. Williamson, secretary; Levi Huffman, treasurer; George Champe, of Toledo, chief engineer. The final survey of the road will be begun at once, and several agents will be put to work buying the right of way preparatory to immediate construction.

INDIANAPOLIS, IND.—The annual meeting of the stockholders of the Indianapolis Traction & Terminal Company was held here Wednesday, June 8. The only change was that in the election of John J. Appel to succeed James M. Jones as second vice-president of the company. Mr. Jones resigned recently. His place as assistant general manager was not filled. The officers are Hugh J. McGowan, president; H. P. Wasson, first vice-president; John J. Appel, second vice-president, and W. F. Millholland, secretary and treasurer.

SIGOURNEY, IA.—Twenty-five hundred dollars has been raised and a board of directors selected for a company which proposes to construct an electric interurban railway from Sigourney to Newton. The board of directors is as follows: C. B. Holmes, of Chicago, president: H. G. Brown, Thomas Kelly, J. W. Lesan, and others.

PADUCAH, KY.—Word is received here of the financing in New York of the Kentucky & Ohio River Electric Railway, which plans to build from Paducah to East Cairo, Ky.; thence possibly across the river to Cairo, Ill. J. J. Freundlich, of Paducah, and W. H. Paul, of East St. Louis, are interested.

GULFPORT, MISS.—Col. J. T. Jones, of this place, who is interested in the electric railway now under construction here, says the line will most likely be built to Biloxi, Mississippi City and Pass Christian. Financial interests recently looked into such a proposition, and are said to be willing to put up the money.

WILLIAMSTOWN, MASS.—The Hoosac Valley Street Railway Company has completed the plans for the new line from the Williamstown station to the Vermont line.

ST. PAUL, MINN.—It is reported that St. Paul men, among whom is President A. B. Stickney, of the Chicago Great Western road, are considering a proposition to build an electric railway in Minnesota, to run south from St. Paul to Rochester, linking a number of small towns.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Railway Company plans the construction of another belt in the West End. A franchise application has been presented to the Council asking for permission to lay tracks in seven streets.

PATCHOGUE, N. Y.—The South Shore Traction Company is soon to apply to the Railroad Commissioners for permission to build its line. The line will extend from the New York line at Central Avenue, Jamaica, to the Connecticut River at Brookhaven, a distance of 60 miles, a considerable portion of which will be over private right of way. The following are directors for the first year: R. Lee Slingluff, A. C. Hume, James A. Hawes, S. H. Thompson, F. D. Shaffer, Samuel Worthington, Edward Phillips, Charles Hall Davis, C. G. Perrott. James F. Heyward, formerly connected with the electric railways of Baltimore, is interested in the company as a stockholder.

STEUBENVILLE, OHIO.—The Steubenville & Canton Railway Company has been incorporated, with a capital stock of $10,000, to build an electric railway from Steubenville to Canton, there to connect with the electric railway to Cleveland. The incorporators are Howard H. Smith, Elmer E. Francy, Thomas H. Loomis, Sheridan B. Pyle, James Carl Bibber.

CINCINNATI, OHIO.—The owners of the Cincinnati Interurban Railway Company, operating between Cincinnati and Hamilton, are planning extensive improvements to the portion of the road south of Carthage, in order to make it possible to run the large interurban cars into Cincinnati without change.

POTTSTOWN, PA.—After a fight to enter the borough, lasting over a year, the Pottstown & Reading Street Railway Company has finally been granted a franchise by the Council.

JERSEY SHORE, PA.—The newly chartered Jersey Shore-Antesfort Railway Company has secured a site in this place for a power house. The capital stock is $30,000 and the steam road act, under which the company is chartered, gives it the right to carry freight.

BRADFORD, PA.—A special meeting of stockholders of the Bradford Electric Street Railway Company, and the Olean, Rock City & Bradford Railway Company, will be held in this city July 29 for the purpose of voting on an increase of the companies' indebtedness.

WAYNESBORO, PA.—Surveys have been completed to Pen-Mar of the proposed Catoctin & Meyersville Electric Railway. Connections will be made at Pen-Mar with the Chambersburg, Newcastle & Waynesboro line. The line as surveyed for the Catoctin & Meyersville road runs from the Frederick-Middletown line at Myersville, to Pen-Mar Station, Western Maryland Railroad, a distance of 22 miles. The incorporators of the new road have elected the following officers: J. H. Maugans, president; A. H. Hauver, vice-president; H. M. Warrenfeltz, secretary; Chas. U. Grossnickle, treasurer.

HOUSTON, TEX.—Surveys are now being made for the proposed electric railway between Houston and Galveston. Col. Slosson, of Houston, is the chief promoter.

NEW INDUSTRIAL COMPANIES.

THE DOSSERT ELECTRICAL APPLIANCE COMPANY, of New York, has been incorporated with a capital stock of $5000. The directors are: W. F. Blake, Sound Beach, Conn.; James C. Minehan, Albany, and J. E. Calder, New York.

THE DAVID ELECTRIC LIGHT COMPANY, of Alton, Ill., has been incorporated with a capital stock of $2000. The company will conduct a business of electrical construction. The incorporators are: C. B. Davis, B. C. Davis and C. E. Whitney.

THE AUTOMATIC ELECTRIC PUMP COMPANY, of Davenport, Ia., has been incorporated with a capital stock of $30,000. The officers of the company are: President and treasurer, Henry Brehmer; vice-president, William J. Pugh, and secretary, F. J. Peto.

LEGAL.

RESPONSIBILITY FOR ACCIDENT.—In the suit of Wendler vs. the Red Wing Gas & Electric Company, the Supreme Court of Minnesota has held: 1. The doctrine that the master is not in law bound to instruct an employe as to special dangers incident to the employment if such information is fully within his knowledge, reaffirmed. 2. Certain evidence adduced at the trial fails to show prima facie that an injury was inflicted upon appellant by the negligence of respondent in failing to furnish and maintain proper electrical appliances in conducting its electric light plant, or from failing to keep the same in a safe condition.

BELL WESTERN-UNION ROYALTIES.—Special Master Everett W. Burdett has started hearings in the American Bell Telephone-Western Union Telegraph Company royalty suit, in accordance with the degree of Judge Colt, of the United States Circuit Court, as of Feb. 3, 1904, ordering the American Bell Telephone Company to furnish an accounting to determine to what extent it is obliged to the Western Union Telegraph Company for failure to turn over for 17 years 20 per cent. of stock and dividends it received from sub-companies, in addition to 20 per cent. of the cash rentals. The rental and royalty contract was made between these companies in November, 1879. The amount involved is between $2,000,000 and $4,000,000. In return for these royalties and rentals the Western Union agreed to go out of the telephone business, and turned over all its telephone property to the Bell Company, the latter also agreeing not to interfere with the telegraph business.

GRANT OF RIGHTS IN STREETS.—The Supreme Court of Nebraska in the appeal by the Nebraska Telephone Company to prevent the city of Fremont from destroying its poles and wires, has sustained the lower court and has ruled: 1. When a city ordinance prescribes that permission to occupy the streets by a public service corporation shall be obtained with the consent of the mayor and council, such consent is sufficiently proved by an entry in the records of a meeting of the council, presided over by the mayor, reciting that a motion granting it was offered by a member and adopted; there being nothing to indicate that the mayor dissented. 2. Forfeiture of the franchises and easements of a public service corporation in the streets can be declared and enforced only by a court of competent jurisdiction. The city claiming a forfeiture cannot be a judge in its own cause, or invade the privileges or destroy the property of such a corporation in the absence of judicial warrant for so doing.

CHARGES AGAINST PATENT OFFICE.—In the matter of the charges of Thomas A. Edison against two examiners in the Patent Office, in connection with the grant of letters-patent for an electrical invention by Ernest W. Jungner, the Secretary of the Interior has approved an opinion rendered by Assistant Attorney General Campbell. The opinion holds that nothing is shown in Mr. Edison's petition that involves any cause for the exercise of supervisory authority at the hands of the Secretary, and for that reason the Secretary is advised that the Commissioner of Patents should be left to his own discretion in dealing with the case. The transfer of the examiners from one division to another is recommended by Acting Commissioner Moore, of the Patent Office. Mr. Edison charged "incompetence, neglect of duty and maladministration of office in connection with the grant of a United States patent to Ernest W. Jungner for reversible galvanic battery, No. 738,110, dated September 1, 1903." The findings of Acting Commissioner Moore were that there was absolutely no evidence of malfeasance or intentional wrongdoing on the part of the examiners.

INJURY THROUGH NEGLIGENCE.—In the appeal of Baries vs. Louisville Electric Light Co., for personal injury, the Court of Appeals of Kentucky has reversed the verdict of the lower court for the defendant on various grounds as follows: 1. Under Code Civ. Prac. § 341, providing that a new trial shall not be granted on account of the smallness of the damage in an action for an injury to the person or reputation, nor in any other action in which the damages equal the actual pecuniary injury sustained, a verdict and judgment for one cent for personal injuries resulting in loss of time worth about $800 may be reversed. 2. Plaintiff in a personal injury action alleged that he had been and was unable to do any kind of work. The evidence showed that the time lost by him in consequence of his injury would equal more than $800. The jury gave him a verdict of one cent. Held that, as he had not pleaded special damages, he was not entitled to a reversal. 3. A verdict of one cent for a personal injury consisting of a withered arm, from which plaintiff appeals, will be treated by the Court of Appeals, in considering the errors alleged, as one for appellee. 4. An electric light company, whose failure to properly insulate its wire on a building results in injury to a house painter at work thereon, is not relieved from the consequences of its negligence because the painter's employer knew that the company desired to cut the wire when that portion of the building was to be painted, or because there was a custom that contractors should notify the company when working on houses to which its wires were attached so they could be cut, though the company received no notice in this instance. 5. Where an electric light company had actual notice that house painters were at work on a building to which its wires were attached, evidence of a custom to give it notice of the fact so the wires could be cut is inadmissible in an action by a painter for injury from a defectively insulated wire. 6. The improper admission of evidence in a house painter's action against an electric light company for injuries from a defectively insulated wire on the building he was painting, that a custom existed to notify the company that painters were at work so its wires could be cut, is ground for reversal.

PERSONAL.

MR. C. T. YERKES has sailed again for England to watch his London underground electric railway enterprises.

MR. JOHN A. HEANY has been awarded the John Scott medal of the Franklin Institute, for his magnetic-clutch arc lamp.

MR. H. BEVIS, director of the General Electric Company, Ltd., of London, is again in this country on one of his frequent trips.

MR. J. M. ANDERSON, of the Albert & J. M. Anderson Manufacturing Company, Boston, Mass., was in New York this week.

MR. JOHN G. EMERY, manager of the Shaw Electric Crane Company, Muskegon, Mich., was on a visit to New York for a few days last week.

MR. J. F. FAIRMAN, author of "Telephone Wiring," now in press, has accepted a position with Waterbury & Company, New York City, in their electrical sales department.

MR. ERNST J. BERG, of the General Electric Company, was married week before last to the daughter of Hon. Morgan J. O'Brien, Justice of the New York State Court of Appeals.

MR. F. P. THORP, who has been representing the Power & Mining Machinery Company at Boston, Mass., is now in charge of the Pittsburg offices of that company located in the Farmers' Bank Building.

MR. F. W. PARDEE, who for some time had charge of the telephone department of the Chicago Writing Machine Company, has accepted the position of general manager with Frank B. Cook, of that city.

PROF. W. HALLOCK is to lecture on the influence of radium and other radio-active substances on ionization and the conduction of electricity in gases, with illustrations, during the fifth summer session of Columbia University, which will begin July 6.

MR. H. D. WALBRIDGE has been elected president of the Rochester, N. Y., Gas & Electric Company in the place of Mr. G. W. Archer, and will have associated with him in the management, it is said, Mr. W. M. Eaton, formerly general manager of the Grand Rapids Gas Light Company.

MR. FRANK B. COOK returned recently from a trip to the Black Hills, where he had been looking after his interests in the Deadwood Home Telephone Company, which he owns. He reports the company in a flourishing condition. Mr. Cook returned by way of Omaha, Council Bluffs and Des Moines.

MR. FRANCK Z. MAGUIRE made a demonstration before the Royal Society last year of the Cinematograph in application to travel, engineering, plant growth, cloud effects, etc., and has just issued in pamphlet form his remarks directing attention to interesting features of this work, and its possibilities.

MR. E. B. SWINDEN, of the Montevideo firm of Swinden & Acosta y Lara, which concern is a considerable handler of Yankee electrical supplies, machine tools, etc., is now on a short visit to the United States. He may be reached by addressing the New York banking house of H. B. Hollins & Co., 15 Wall Street.

MR. H. J. M. ELLIS, of H. J. M. Ellis & Company, New York, is now on a visit from Singapore for the purpose primarily of making arrangements with American manufacturers of electrical equipment, supplies, machine tools, etc., to represent their interests in the East Indies. Mr. Ellis intends to sail for Singapore on July 2.

MR. GEORGE E. WILLARD, of the Syndicate of American Manufacturers, 24 South William Street, which concern conducts a considerable business in electrical equipment, supplies, etc., for the South American markets, is about to leave on a trip to the Argentine Republic and the west coast of South America. He expects to be absent fully six months.

MR. R. CRAWFORD has been promoted from superintendent to general manager of the Stamford, Conn., Gas & Electric Company, and Mr. G. B. Leland has been appointed superintendent in his place. Mr. Crawford is also devoting time to the Oven Equipment & Manufacturing Company, a new concern which is making a specialty of gas burners for enameling ovens and core ovens; also for all special heating work.

MR. GUSTAF L. OBERG, secretary and general manager of the Shanghai, China, Mutual Telephone Company, is spending several weeks in the United States on his way to a short visit to his former home in Sweden. The Shanghai exchange has grown so rapidly that plans have been prepared for a large new building which will be equipped with new exchange apparatus, including a 30,000-station switchboard. During his stay in this country Mr. Oberg has visited some of the most recent exchanges, and it is quite probable that the equipment for the new exchange will be purchased in this country.

MR. G. MARCONI made but a short stay here and has sailed again for Europe. Before leaving he stated that the Cape Cod station would be opened very soon for the receipt of wireless messages for the Cunard Line steamers from Boston, as well as the other steamships of the trans-Atlantic fleet. During his return voyage Mr. Marconi will equip the *Kaiser Wilhelm* with his new receiving apparatus. Discussing the reported intent of the United States Government to control wireless telegraphy in the United States, Mr. Marconi said he felt no uneasiness or apprehension as to such action and expressed the opinion that no attempt would ever be made to carry out the reported plan.

Trade Notes.

COLUMBIA LAMPS are the subject of some very pretty and tasteful "dodgers" and folders issued by the Columbia Incandescent Lamp Company, of St. Louis.

THE EMPIRE ELECTRIC SUPPLY COMPANY, of Chicago, reports a large demand for Yost sockets, of which it carries a large and complete stock for prompt delivery.

BULLOCK BULLETIN.—Bulletin No. 1020 of the Bullock Electric Mfg. Company is devoted to multipolar motors and generators. The first section of the book illustrates the various parts in complete detail, and the latter part gives a number of engravings of plants that have been installed.

THE TETER-HEANY DEVELOPING COMPANY, York, Pa., has opened business in manufacturing wire insulated with its fireproof insulation. Its product has already met with widespread approval and success, and in consequence of the demand it has begun to enlarge its plant at York.

MR. HORACE F. RUGGLES, 106 Wall Street, New York City, has secured a large Cuban contract for sugar machinery which will be electrically operated. He is figuring on a substantial contract for a sugar plant to be installed in Porto Rico, in which electrical machinery will play an important part.

NERNST LAMP COMPANY.—The Chicago office of the Nernst Lamp Company, in charge of A. E. Fleming as district manager, has been removed from 638 National Life Building, La Salle Street, to 99 E. Lake Street. The new offices are larger and better equipped in every way to care for the increasing business of the company in that locality.

TELEPHONE SUPPLIES.—Bulletin No. 12 of the Empire Electrical Supply Company, 55 W. Jackson Boulevard, Chicago, illustrates a large number of telephone instruments and small types of switchboards. Particular stress is laid upon the "Empire No. 15" receiver, which is claimed to be the most efficient, sensitive, serviceable receiver made.

B. F. STURTEVANT COMPANY announces the removal of its entire plant from Jamaica Plain to Hyde Park, Mass. The new plant has nine acres of floor space and is equipped throughout with the most modern appliances for the manufacture of the well-known Sturtevant products: blowers, engines, motors, economizers, forges, steam heating, ventilating and drying apparatus, etc.

NORTHERN ELECTRICAL MFG. COMPANY, of Madison, Wis., has issued a very neat little leaflet or folder devoted to sawmill practice. One picture in it shows an Italian sawmill of the primitive type—two men sweating over a beam with a hand saw, and two other pictures show a northern spherical motor driving a swing cut-off saw and a Fay buzz saw. The contrast makes a good resetting of an old saw.

LAMBERT SCHMIDT TELEPHONE MFG. COMPANY, of Weehawken, N. J., shows in its catalogue No. 11 on interior telephones an interesting variety of apparatus for private and intercommunicating telephone purposes. All its telephones for this work are equipped with special long-distance cartridge type transmitted and double-pole receiver, and work on its patented central energy circuit, which requires but one bank of batteries.

AN INCANDESCENT LAMP that can stand up under the jolts and jars and hard knocks of street car service is a rare article and few are the factories that can produce it. The Electric Appliance Company, of Chicago, however, claims to have a lamp fitted for this strenuous service and as proof of its statement the company points with pride to the many large traction companies throughout the country which have adopted the Packard railway lamp.

PELTON WATER WHEELS.—The Pelton Water Wheel Company, San Francisco, informs us that it was awarded the contract for the water wheels for the North Mountain Power Company of that city. The statement in our issue of June 11 that the contract had been given for Stillwell-Bierce wheels was an error. The Pelton Company will furnish two double wheel Pelton units, for direct connection to 750-kw, 500 r.p.m., alternators, the wheels to operate under a 600-foot head.

THE F. BISSELL COMPANY, Toledo, Ohio, has added to its list of specialties, novelty potheads, sleeves, terminal heads, etc., for telephone cable work. This business has been purchased outright from the New Haven Company, the transfer including all patents, special machinery, good will and merchandise, finished and unfinished. The Bissell Company announces that, owing to its very advantageous location and special additional facilities, it will be in much better position to serve the trade promptly and satisfactorily.

GARTON LIGHTNING ARRESTERS are the theme of catalogue No. 40, recently issued by the Garton-Daniels Company, of Keokuk, Ia. A large part of this handsome pamphlet is devoted to a discussion of the principles of the subject and the successful manner in which the company's system has been worked out as a preventive and cure of lighting and other "strikes" of a high voltage character. The Garton arrester and its application are clearly illustrated, as well as kicking coils and other details. It is a most interesting summary of the subject.

"NORBITT" TEMPORARY SOCKETS.—At the Elks' convention, to be held in Cincinnati, July 8 to 25, there will be used nearly 30,000 "Norbitt" porcelain temporary sockets for decorative purposes, illuminating the streets for thirty-seven blocks. Oven 500 "Norbitt" temporary sockets will also be used in making a huge American flag, which is to be hung over Government Square. These handy little devices, which can be installed in a very few moments without scraping the insulation from the wire, are manufactured by the Crouse-Hinds Company, of Syracuse, N. Y.

ABNER DOBLE COMPANY, of San Francisco, engineers, manufacturers of tangential water wheels with needle regulating nozzles, dealers and manufacturers in iron, steel and metals, announce the organization of its consulting engineering department, in charge of Mr. Robert McF. Doble, who has had considerable experience in the design, construction and operation of high head hydro-electric power plants and long distance power transmissions. Abner Doble Company is now prepared to take entire charge of the design and construction of power plants, pumping plants and other engineering work.

UNIVERSAL ELECTRIC COMPANY.—A new organization known as the Universal Electric Company, jobbers in everything electrical, has opened general sales offices in the Ellsworth Building, 353 Dearborn Street, Chicago, Ill. Its executive officers are F. C. Royal, president, and F. B. Kavanaugh, secretary and treasurer. Mr. Royal is a well-known Chicago business man, having been connected with the Nelson & Morris packing house for a number of years, while Mr. Kavanaugh was formerly with the Sterling Electrical Mfg. Company, Warren, Ohio, and late with the Brilliant Electric Company, Cleveland, Ohio. The new company is the Northwestern distributer for the Brilliant Electric Company, of Cleveland, Ohio, makers of the Universal tipless incandescent lamps. In addition to this product it will job a full line of arc lamps, fans, motors, generators, telephone systems, etc., as well as several special lamp accessories.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 14, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

762,279. TELEPHONE LAMP-JACK; Henry P. Clausen, Chicago, Ill. App. filed Oct. 12, 1901. (See page 1198.)

762,297. THIRD RAIL INSULATOR; Henry L. Fritze, Jersey City, N. J. App. filed Oct. 27, 1903. Details.

762,318. CONDUCTOR AND COLLECTOR FOR ELECTRIC RAILWAYS OR TRAMWAYS; Donald Kempt, Buenos Ayres, Argentina. App. filed March 11, 1903. A number of sharp-edged disks run in the groove of a third rail to take off the current.

762,319. CONTACT BOX AND CONDUCTOR FOR ELECTRIC RAILWAYS OR TRAMWAYS; Donald Kempt, Buenos Ayres, Argentina. App. filed Sept. 23, 1903. Details.

762,331. ELECTRIC SIGNAL; Wm. D. Marks, Westport, N. Y. App. filed March 12, 1903. Details of a block signal system.

762,336. SIGNALING APPARATUS FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill. App. filed Feb. 20, 1902. (See page 1198.)

762,337. SIGNAL FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill. App. filed July 2, 1902. (See page 1198.)

762,338. RELAY; Frank R. McBerty, Evanston, Ill. App. filed Oct. 27, 1902. (See page 1198.)

762,341. EARTH OR GROUND WIRE ATTACHMENT; Joseph J. O'Connel, Chicago, Ill. App. filed March 10, 1904. A spring bracket is bound to a water or gas pipe by turns of the conductor to be grounded and extra tension or strain is put upon the turns to perfect the contact by a screw working through the bracket and against the pipe.

762,358. ELECTRIC METER; William Stanley, Great Barrington, Mass. App. filed Dec. 6, 1901. While an oscillating needle is approaching the medial line of its oscillation, the magnetic field is increased independently of variations in the load which determines the normal working field.

762,364. TELEPHONE-CALL INSTRUMENT; Edward W. E. Tompson, Brookline, Mass. App. filed May 18, 1903. (See page 1198.)

762,370. ELECTRIC SIGNALING SYSTEM; Samuel M. Young, New York, N. Y. App. filed Jan. 19, 1903. A system in which the cars are moved by direct current and the signals by an alternating current, the latter being transmitted along the conductors conveying the direct current and interference being avoided by the use of properly disposed reactance coils.

762,379. TROLLEY WHEEL; John S. Briggs, Los Angeles, Cal. App. filed April 25, 1903. In the tread of the wheel, a spring is wound to give yielding contact with the wire to avoid arcing.

762,391. TELEPHONE FIRE-ALARM SYSTEM; William L. Denio, Rochester, N. Y. App. filed May 11, 1903. (See page 1198.)

762,409. SYSTEM OF MOTOR CONTROL; George H. Hill, Glenridge, N. J. App. filed Nov. 3, 1903. A motor control system in which the power-actuated switches are automatically operated in succession and in which the progression may be stopped at any desired point; a master controller is used and the motorman can operate at any speed he desires independently of the automatic progression.

762,410. SAFETY APPARATUS FOR USE WITH OVERHEAD ELECTRIC CONDUCTORS; Herbert F. Hill, London, England. App. filed June 10, 1903. A grounding wire is supported adjacent to a trolley wire and the latter carries brackets arranged to come in contact with the grounding wire in case the trolley wire unduly sags or breaks.

762,425. ELECTRICAL BATTERY; John Roger Lord, San Francisco, Cal. App. filed June 5, 1903. (See page 1198.)

762,430. ELECTROMAGNETIC SIGNAL; Frank R. McBerty, Evanston, and Frederick H. Loveridge, Chicago, Ill. App. filed May 9, 1902. (See page 1198.)

762,432. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; James L. McQuarrie, Chicago, Ill. App. filed May 9, 1902. (See page 1198.)

762,503. ELECTRIC ARC LAMP; Gesa Szuk and Wenzel Hackl, Budapest, Austria-Hungary. App. filed June 3, 1903. Details.

762,535. ELECTRIC PLUG OR SOCKET EXTENSION; Wm. H. Kelsey, Cambridge, Mass. App. filed Oct. 9, 1902. A block of insulating material having a plurality of openings therein containing the parts of lamp sockets or receptacles whereby a number of lamps may be connected with a single plug.

762,571. SWITCH PLATE; John Alexander, Hartford, Conn. App. filed Oct. 29, 1903. The plate is cheaply made by electro-depositing a hard metal face upon a cheap metal body.

762,620. PUMP CONTROLLER SYSTEM; Authur C. Eastwood, Cleveland, Ohio. App. filed Feb. 13, 1903. A magnetic clutch is placed between the motor and the pump, so that the motor may be run continuously and the pump connected when necessary.

762,621. MAGNETICALLY OPERATED SWITCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed July 27, 1903. Details.

762,622. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed March 5, 1904. A series of plates alternately carried by the two clutch members, provided with an arrangement of wedges to take up the wear, a coil supplying the necessary magnetism to bring the plates into frictional contact.

762,623. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 1, 1904. The two magnetic members together form one clutch member and clamp between them the edge of the other clutch member, the latter not being in the magnetic field.

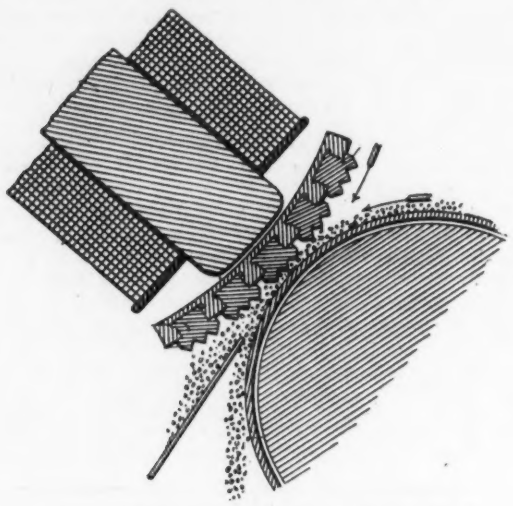
762,628. APPARATUS FOR PROMOTING FLOW OF OIL AND GAS IN WELLS; Fulton Gardner, Chicago, Ill. App. filed Jan. 25, 1904. A number of electric heaters arranged to be placed at intervals in a well and connected on one circuit.

762,644. ELECTRIC KEY SELECTING AND STRIKING MECHANISM; Andrew J. Leonard, Denver, Colo. App. filed Feb. 21, 1902. A number of comparatively small magnets are used to select the key to be operated, while a single large magnet accomplishes the striking of any selected key.

762,669. INSULATED RAIL JOINT; George A. Weber and Percy Holbrook, New York, N. Y. App. filed Nov. 13, 1903. An insulated rail joint, comprising the meeting ends of pairs of rails, with a plurality of longitudinally-extending filling blocks arranged side by side between the rails, and bolts for securing the parts of the joint together.

762,671. AUTOMATIC POTENTIAL REGULATOR; Wm. S. Andrews, Schenectady, N. Y. App. filed Oct. 1, 1902. The invention consists of a multiple pole switch having a plurality of pairs of stationary contact segments, a movable arm carrying a single pair of contacts adapted to bridge each pair of stationary segments in succession and terminals connected with the contacts on the arm and adapted to be connected with a voltmeter.

762,675. MULTIPLE POLE VOLTMETER SWITCH; Charles C. Badeau, Schenectady, N. Y. App. filed July 27, 1901. The connector is used between cars and the male and female parts are so constructed that it is impossible to connect together any except the terminals of the same circuit.



762,752.—Apparatus for Magnetic Separation.

762,684. CONNECTOR; Frank E. Case, Schenectady, N. Y. App. filed Oct. 3, 1902. Details.

762,686. ELECTRIC RAILROAD CROSSING SIGNAL; Thomas C. Clark, Cambridge, Ohio. App. filed Dec. 29, 1903. Details.

762,695. SIGNALING APPARATUS; Ernest A. Faller, New York, N. Y. App. filed Oct. 14, 1903. By this apparatus it is proposed to effect from one operation such as the pushing of a button, all that is necessary to provide the motive power for the sending of a signal as well as the locking of the mechanism against duplicate use.

762,697. REACTANCE COIL; John J. Frank, Schenectady, N. Y. App. filed Oct. 16, 1902. A fluid-cooled reactance coil, having a laminated core with air gaps formed in the layers to increase the magnetic reluctance and prevent the formation of stray fields.

762,709. ELECTRIC MOTOR; Gaylord C. Hall, New York, N. Y. App. filed March 7, 1901. In combination with a motor and resistance, means for varying the resistance, oppositely actuated by the difference of potential around the motor and around the resistance.

762,715. ELECTRICAL BATTERY; Julius E. Hasche, Chicago, Ill. App. filed Feb. 8, 1904. (See page 1198.)

762,720. PORTABLE ELECTRIC LIGHT; Conrad Hubert, New York, N. Y. App. filed Jan. 25, 1904. A small pocket case containing battery cells and a bullseye lamp with circuit closer.

762,735. MANUFACTURE OF INSULATED OR COVERED WIRES AND MACHINE THEREFOR; Charles Martin, Nottingham, England. App. filed May 18, 1903. A machine for successively placing upon a wire layers of yarn and of rubber and finally a knitted layer.

762,738. AUTOMATIC REGULATOR FOR MOTORS; Hans S. Meyer, Rugby, England. App. filed Sept. 4, 1902. An induction motor-regulating device which will vary the potential so as to cause it to decrease with an increase of speed of the motor and to increase with a decrease of speed and which is controllable by the speed of the motor.

762,744. MEANS FOR REGULATING DYNAMO ELECTRIC MACHINES; Charles R. McKay, Cincinnati, Ohio. App. filed Nov. 23, 1901. A dynonometer connected across two of the leads of a three-phase circuit, actuates the arm of a rheostat connected across the armature terminals of a dynamo.

762,749. TROLLEY; Rowley K. Ortt, Reading, Pa. App. filed Nov. 4, 1903. The wheel is swiveled on ball bearings to turn laterally to accommodate itself to kinks in the wire.

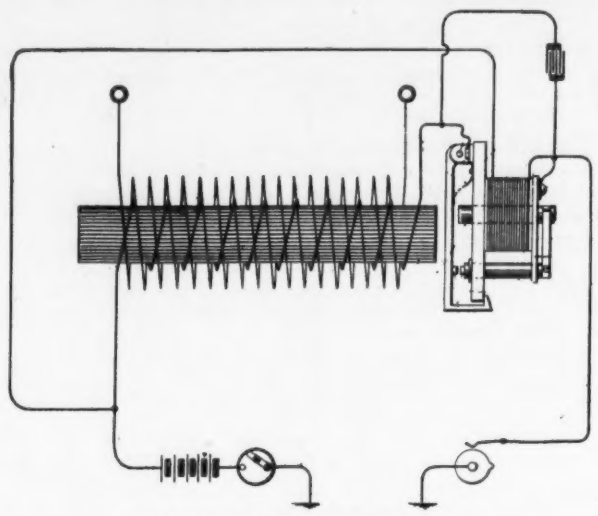
762,751. SEPARATING CYLINDER FOR MAGNETIC SEPARATORS; Clarence Q. Payne, Stamford, Conn. App. filed Aug. 17, 1901. The invention consists in the shape of the pole faces whereby large contact surface for the adherence of magnetic particles is provided.

762,752. APPARATUS FOR MAGNETIC SEPARATION; Clarence Q. Payne, Stamford, Conn. App. filed Aug. 30, 1901. A modification of the preceding invention.

762,753. APPARATUS FOR MAGNETIC SEPARATION; Clarence Q. Payne, Stamford, Conn. App. filed Oct. 3, 1903. A further modification.

762,768. RAIL; Louis Steinberger, New York, N. Y. App. filed Dec. 16, 1903. The third rail is L-shaped in cross section and saddled loosely upon the supports which permit it to rock.

762,769. SUPPORT FOR RAILS; Louis Steinberger, New York, N. Y. App. filed Feb. 11, 1904. Another construction permitting of freedom of movement of an ordinary T-third rail.



762,776.—Induction Coil Vibrator.

762,770. DOOR OPENING APPARATUS; Henry S. Stewart, Chicago, Ill. App. filed March 24, 1904. A magnet controls a dog that holds a door from opening under the tension of a spring; by operating a push button, the door is released and opened.

762,776. INDUCTION COIL VIBRATOR; Richard Varley, Providence, R. I. App. filed Jan. 22, 1904. The vibrator is in a floating condition between the head of the coil on one side and a magnet on the other; the current automatically shunts from one coil to the other and thus actuates the vibrator in opposite directions. All adjusting screws are avoided and the vibrator can be hermetically sealed.

762,791. TROLLEY HANGER; Montraville M. Wood, Schenectady, N. Y. App. filed Dec. 15, 1902. Details.

762,792. ELECTRIC RAILWAY APPARATUS; Granville T. Woods, New York, N. Y. App. filed Oct. 12, 1901. The delivery of current to the sections of a sectional conductor is controlled by four magnets, whose circuits depend upon one another.

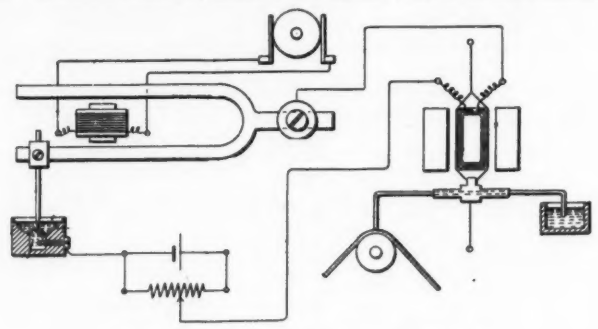
762,798. RAILWAY SIGNALING SYSTEM; Marion A. Born, Lawrenceville, Ga. App. filed Nov. 7, 1902. Details.

762,803. ELECTRICAL ACCUMULATOR; Alfred Jean Baptiste Maxime Colletas, Paris, France. App. filed Sept. 12, 1901. (See page 1198.)

762,812. ELECTRIC SIGNALING SYSTEM; John Dianovszky, Passaic, N. J. App. filed July 18, 1903. Details.

762,820. ELECTRIC TELEPHONE; Ernst Gundlach, Berwyn, Ill. App. filed Feb. 5, 1904. (See page 1198.)

762,821. ALARM SIGNAL; Edward L. Hail and Geo. Hail, Providence, R. I. App. filed May 14, 1902. An elevator car approaching a landing from either direction sounds a signal at the landing until the landing is passed.



762,829.—Receiver for Wireless Telegraphy.

762,823. TROLLEY WHEEL; Stewart J. Hanlin, Allegheny, Pa. App. filed March 29, 1904. Two trolley wheels mounted in tandem.

762,824. FUSE PLUG; Rudolph Hundhausen, Wilmersdorf, Germany. App. filed Nov. 24, 1899. Details.

762,829. RECEIVER FOR WIRELESS TELEGRAPHY; Oliver J. Lodge, Birmingham, Alexander Muirhead, Shortlands, and Edward E. Robinson, Birmingham, Eng. App. filed July 28, 1902. A wave detector consisting of two conducting surfaces having a film of fluid between them capable of being broken down upon the occurrence of a wave and immediately renewing itself.

762,831. TROLLEY BASE; Peter D. Milloy, Buffalo, N. Y. App. filed Oct. 27, 1902. Details.

762,840. FEED WIRE CONNECTION; Geo. L. Osborn, Boston, Mass. App. filed Sept. 2, 1902. A bracket intended to be soldered to the rail and having a pocket in which the end of the wire is soldered.

762,847. STORAGE BATTERY; Max Schneider, Dresden-Paulen, Germany. App. filed Sept. 4, 1903. (See page 1198.)

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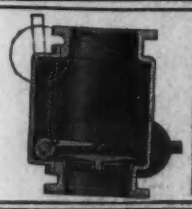
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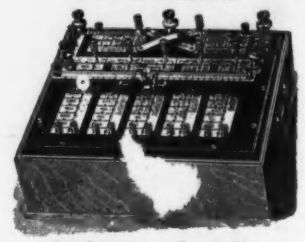

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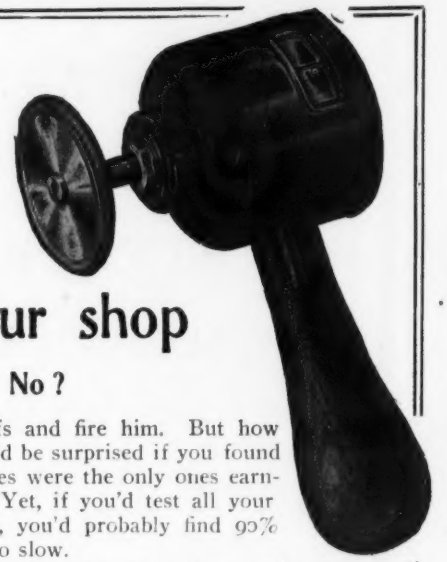

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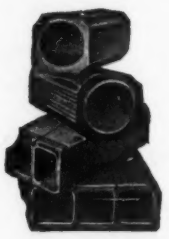

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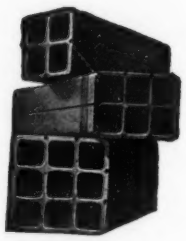

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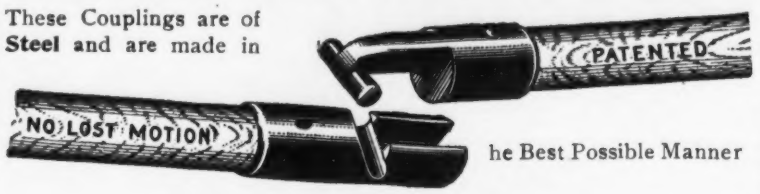

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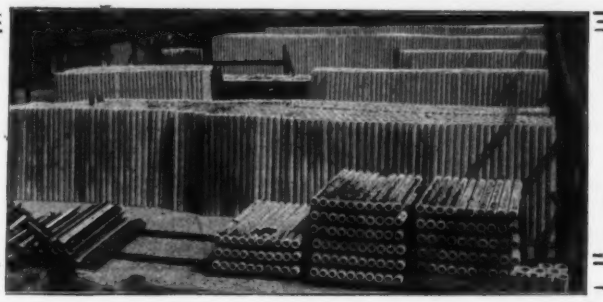

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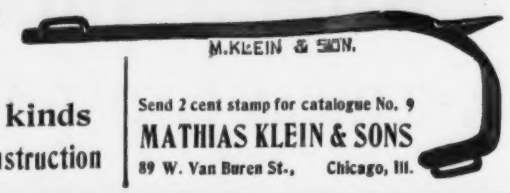

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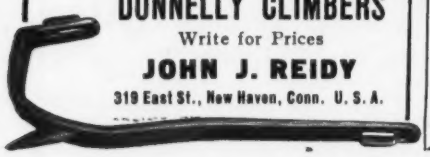

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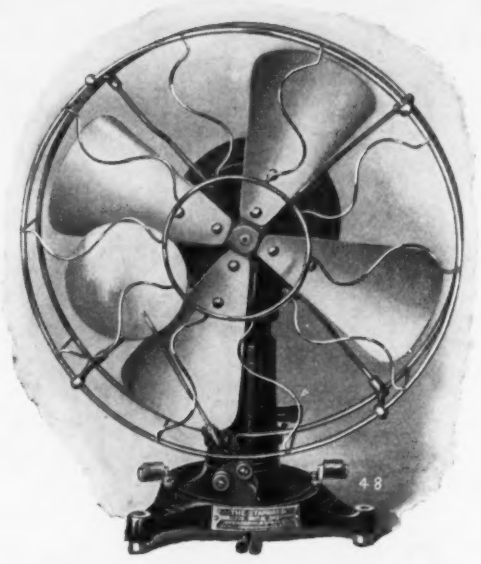

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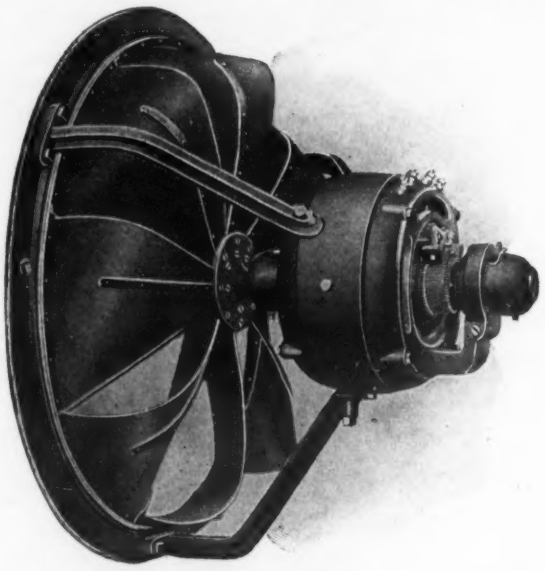

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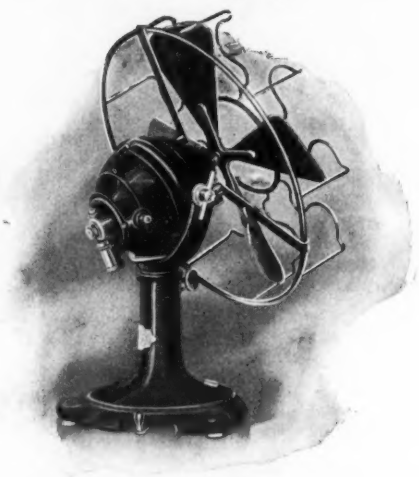

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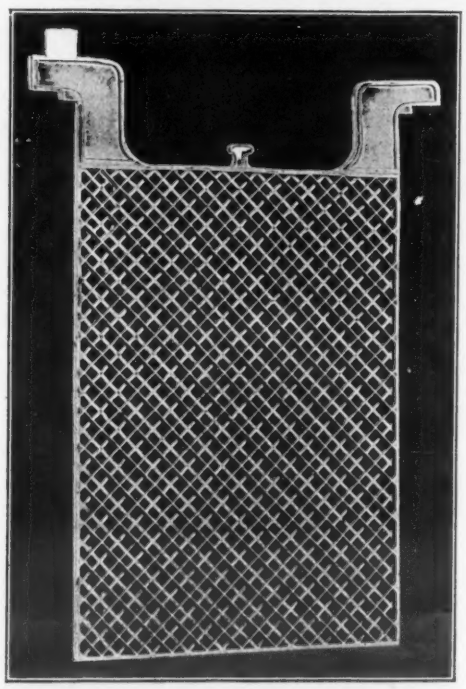

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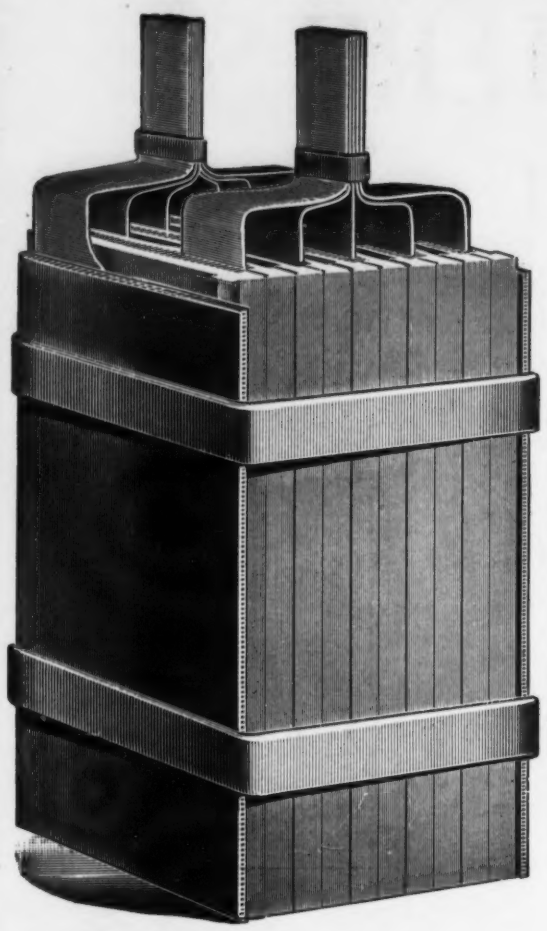

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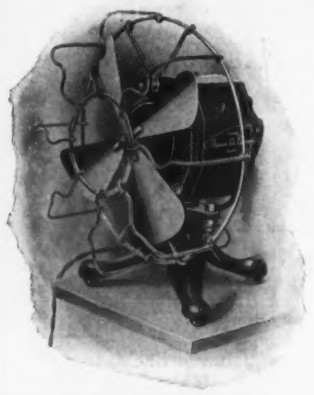

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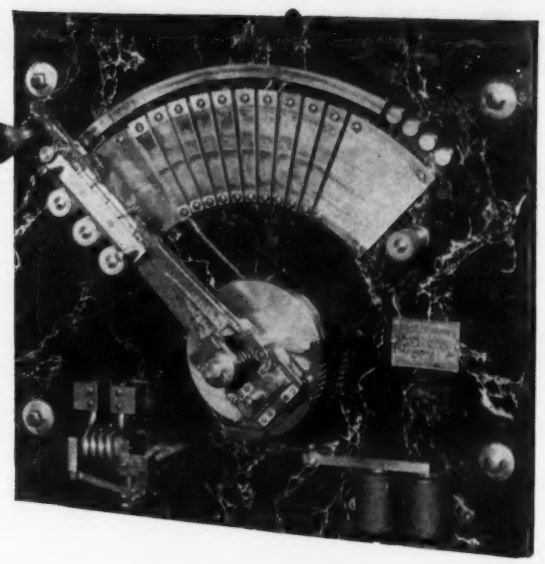

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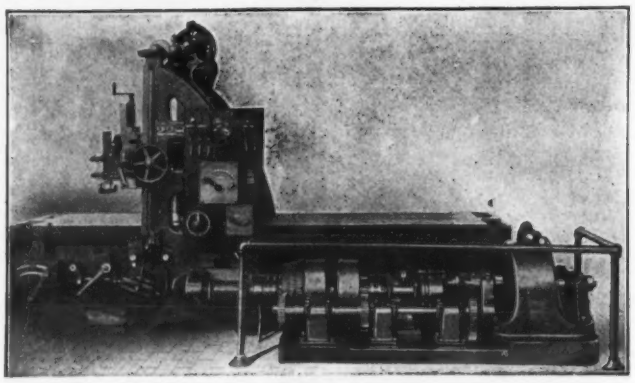

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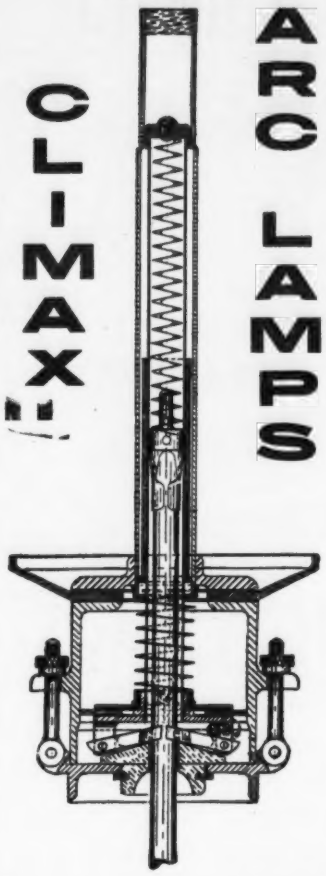

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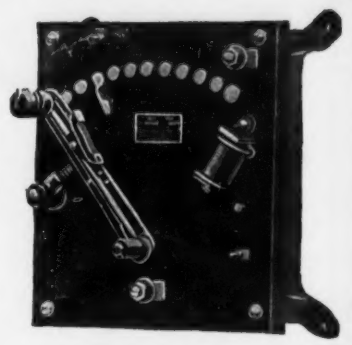

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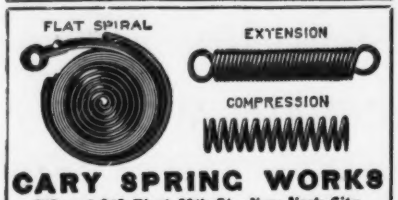

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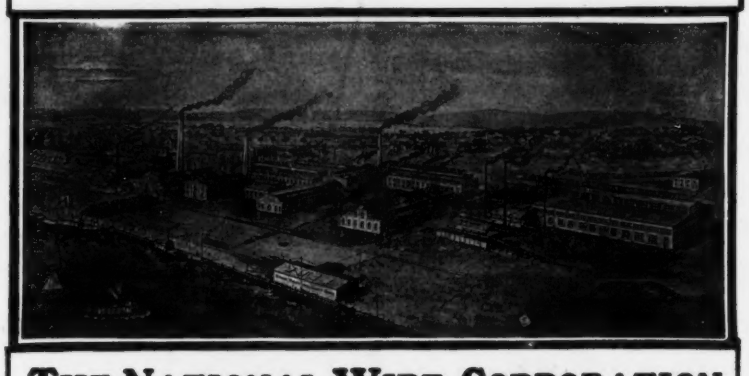

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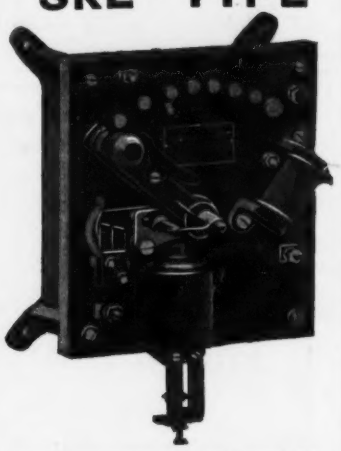

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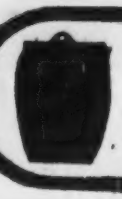

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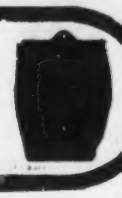

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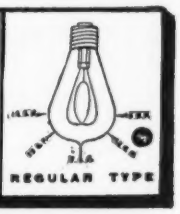

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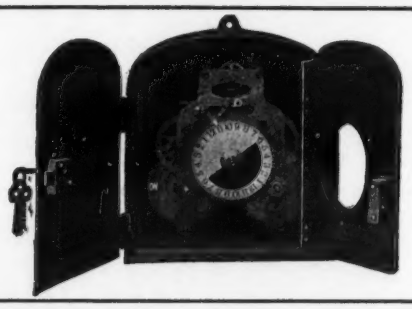

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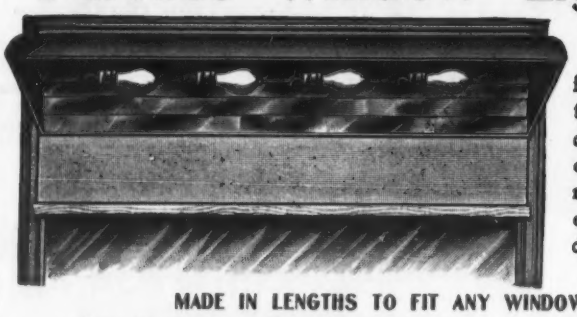

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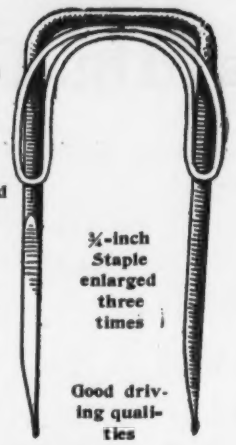

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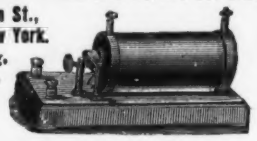

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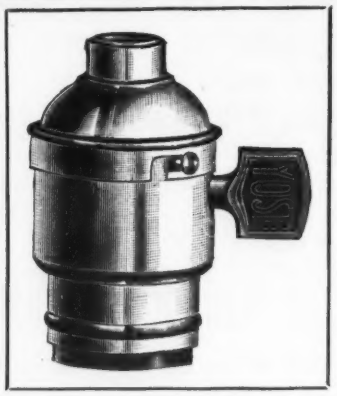

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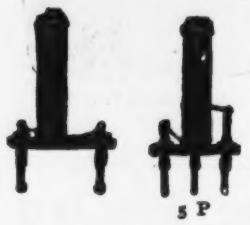

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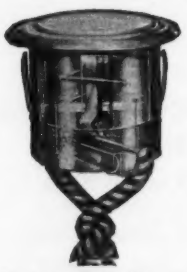

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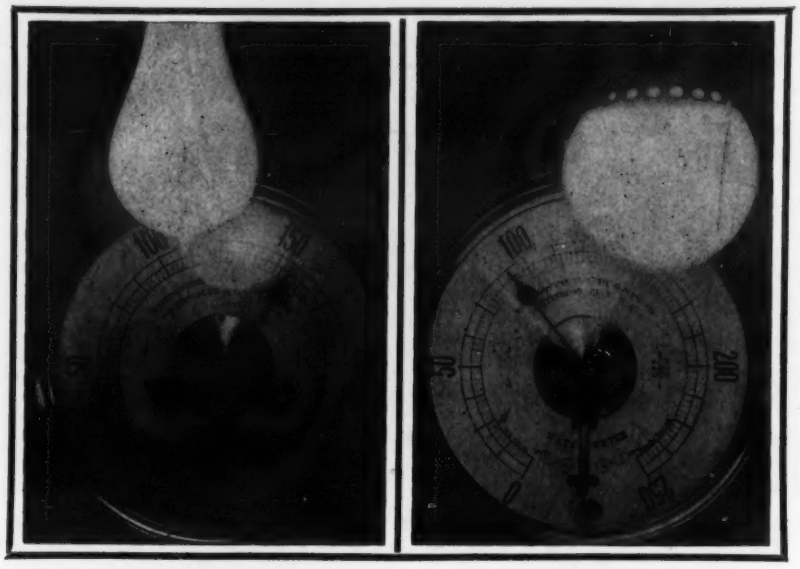

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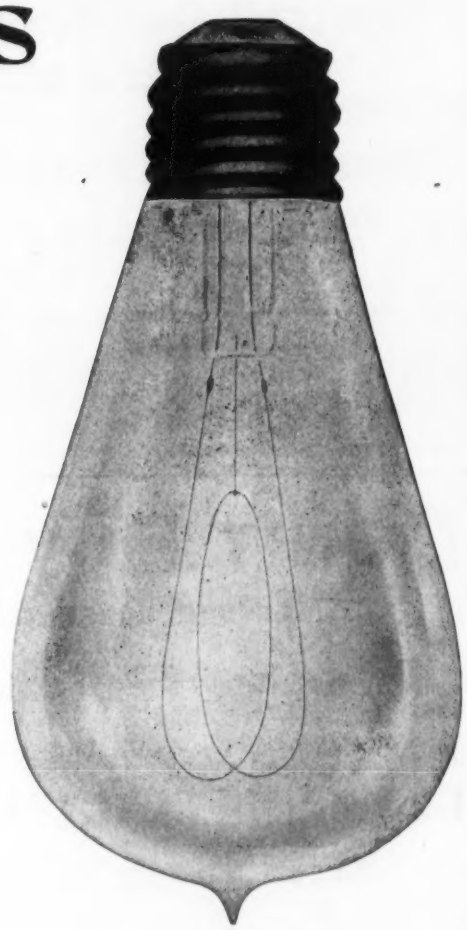

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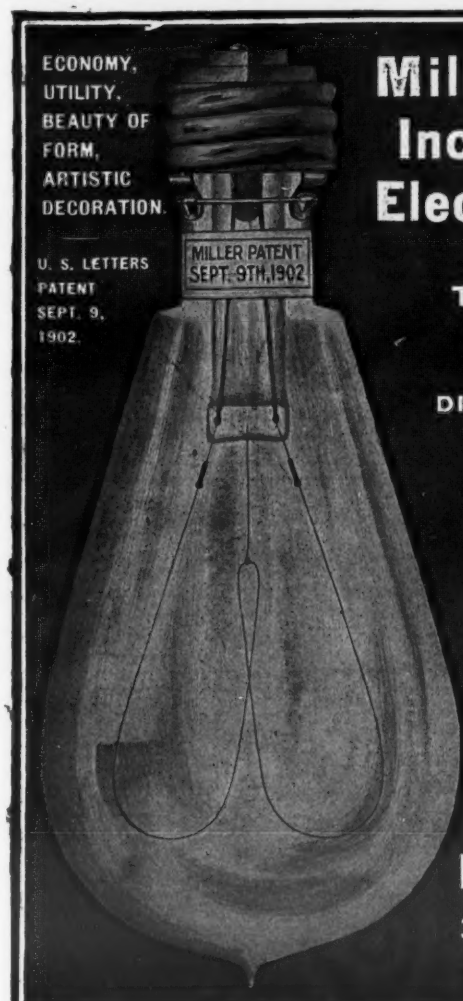

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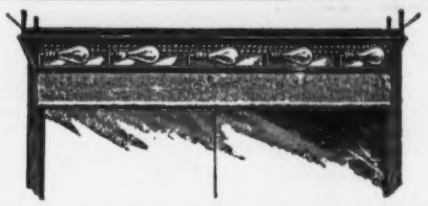

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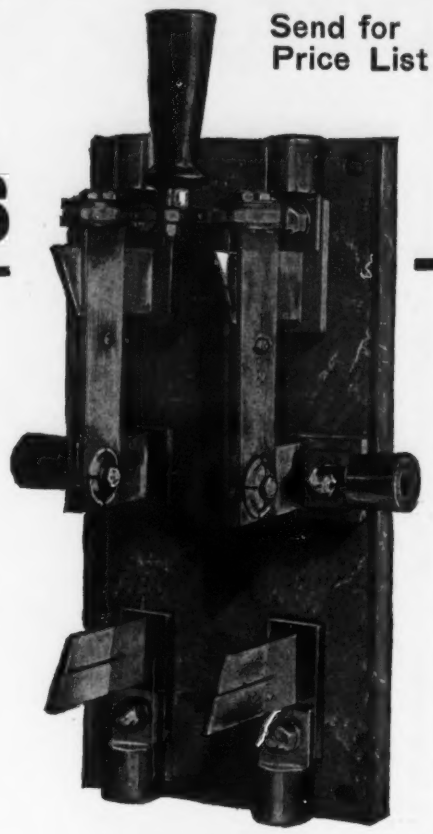

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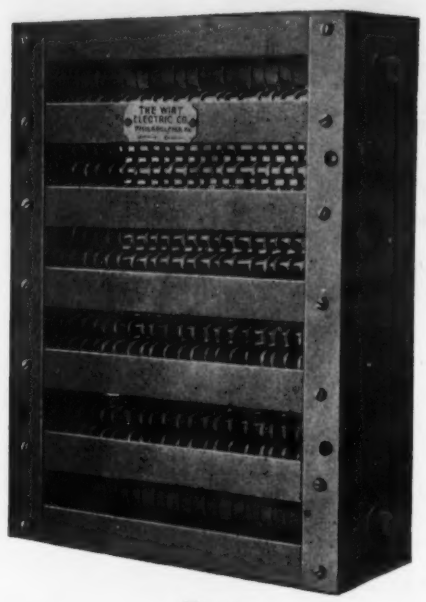

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Wagner Elec. Mfg. Co.
Warner, W. F.
Warren Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC CARRIAGE CALLS.
Edwards & Co.

ELECTRIC HEATING DEVICES.
American Electrical Heater Co.
Johns-Manville Co., H. W.
Kilbourne & Clark Co.
Prometheus Elec. Co.
Simplex Electrical Co.

ELECTRIC LAUNCHES.
Electric Launch Co.

ELECTRIC MINE LOCOMOTIVES.
Jeffrey Mfg. Co.
Muralt & Co.

ELECTRIC NOVELTIES.
Carlisle & Finch Co.
Knapp Elec. & Novelty Co.

ELECTRIC SIGNS.
Colonial Sign & Insulator Co.
Electric Motor & Equipment Co.
Federal Elec. Co.
Haller Machine Co.
Reynolds Elec. Flasher Mfg. Co.
Western Display Co.

ELECTRICAL INSTRUMENTS.
Biddle, James G.
Bristol Co.
Brown & Co., Clifford H.
Cutter Elect'l & Mfg. Co.
Diamond Meter Company.
Dongan Instrument Co.
Duncan Elec. Mfg. Co.
Eldredge Elec. Inst. Co.
Empire Electrical Inst. Co.
Foote, Pierson & Co.
Ft. Wayne Electric Works.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Kelvin & James White, Ltd.
Keystone Electrical Instrument Co.
Leeds & Northrup Co.
Machado & Roller.
Northern Elec'l Mfg. Co.
Pignolet, Louis M.
Queen & Co., Inc.
Stanley Elec. Mfg. Co.
Stanley Instrument Co.
Wagner Elec. Mfg. Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Inst. Co.
Willyoung & Gibson Co.

ELECTRICAL TESTING.
Electrical Testing Laboratories.

ELECTROMAGNETS.
Splitdorf, C. F.
Varley Duplex Magnet Co.

ELECTROPLATING DYNAMOS.
Bogue, C. J.

ELEVATORS.
Jeffrey Mfg. Co.
Link-Belt Engineering Co.

ENGINEERS AND CONTRACTORS.
American Bridge Co.
Arnold Electric Power Station Co.
Baker & Co., W. E.
Barstow, W. S.
Beebe & Bennett.
Brown Electric Const. Co.
Burch, Edward P.
Byllesby & Co., H. M.
Carman & Co., Chas. Whitney.
Chapman, Chas. A.
Coho & Co., H. B.
Collins, A. Frederick.
Corson, Wm. R. C.
Cory, Meredith & Allen.
Doble Co., Abner.
Electric & Steam Engineering Co.
Electrical Equip. & Supply Co.
Engineering Co. of America.
Ford, Bacon & Davis.
Foster, Horatio A.
Fuller Co.
General Engineering Co.
Gest, G. M.
Gherky, W. D.
Hanchett, Geo. T.
Heck, Louis.
Horry, Wm. Smith.
Humphrey, Henry H.
Iron City Engineering Co.
Jackson, Dugald C.
Jackson, William B.
Kelly Engineering Co., John F.
Kilbourne & Clark Co.
King, Willis R.
Kingston, Alfred P.
Kohler Bros.
Linch & Sproehnle.
Mailloux, C. O.
Masson, R. S.
Mershon, Ralph D.
Munroe, Hall & Hopkins.
Muralt & Co.
Palmer, W. K.
Pepper & Register.
Pierce, Richardson & Neiler.
Pratt, Charles R.
Pratt & Atkins.
Reckenzaun, Fred'k.
Sanderson & Porter.
Sargent & Lundy.
Schott, W. H.
Sheaff & Jaasted.
Stanley Elec. Mfg. Co.
Stanton, Le Roy W.
Wagner, Herbert A.
Westinghouse, Church, Kerr & Co.
White & Company, J. G.

ENGINES, GAS AND GASOLINE.
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Carlisle & Finch Co.
Lowell Model Co.
Marinette Gas Engine Works.
Otto Gas Engine Works.
Parsell & Weed.
Power & Mining Machinery Co.
Westinghouse Machine Co.
Wood & Co., R. D.

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American Diesel Engine Co.

ENGINES, STEAM.
Allgemeine Elektricitats Gesellschaft.
Allis-Chalmers Co.
American Engine Co.
Ball & Wood Co.
Ball Engine Co.
Bayley & Sons Co., Wm.
British Westinghouse Elec. & Mfg. Co.
Brush Elec'l Engineering Co.
Buckeye Engine Co.
Carey, Thomas F.
Dick, Kerr & Co.
Frick Co. (Corliss and Automatic).
Fuller Co.
Harrisburg Foundry & Mch. Works.
Ide & Sons, A. L.
Linch & Sproehnle.
Maxfield Francke Co.
McIntosh, Seymour & Co.
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Providence Engineering Wks.
Reeves Engine Co.
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Rochester Mch. Tool Co.
Shepherd Engineering Co.
Skinner Engine Co.
Southwark Foundry & Mach. Co.
Station Equipment Co.
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Tod Co., William.
Thompson-Bonney Co.
Vilter Mfg. Co.
Watertown Engine Co.
Westinghouse Machine Co.
Wetherill & Co., Robt.

EXHAUST HEADS.
Burt Mfg. Co.

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British Thomson-Houston Co.
Central Elec. Co.
Century Elec. Co.
Dayton Fan & Motor Co.
Diehl Mfg. Co.
Doubleday-Hill Elec. Co.
Emerson Elec. Mfg. Co.
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Gen. Inc. Arc Lt. Co.
Holtzer-Cabot Elec. Co.
Hunter Fan & Motor Co.
Jones Fan & Motor Co.
Knapp Electric & Novelty Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Sprague Electric Co.
Stuart-Howland Co.
Western Electric Co.

FANS, EXHAUST & VENTILATING.
Diehl Mfg. Co.
Fuller Co.
Mechanical Appliance Co.
Sturtevant Co., B. F.

FIBRE.
American Vulcanized Fibre Co.
Compressed Fibre Co.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Scranton Button Co.
Siemon Hard Rubber Corporation.
United Button Co.
Vulcanized Fibre Co.

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Dale Company.
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Stow Mfg. Co.

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American Stoker Co.
Sturtevant Co., B. F.

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American Stoker Co.
Green Fuel Economizer Co.

FURNACES.
American Stoker Co.

FUSES.
American Electric Fuse Co.
Anyun Fuse & Elec'l Co., Inc.
Brush Elec'l Engineering Co.
Central Elec. Co.
Chase-Shawmut Co.
Chicago Fuse Wire & Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.

GAUGES, STEAM.
Crosby Steam Gage & Valve Co.
Lunkenheimer Co.

GAS LIGHTING APPARATUS.
Ostrander & Co., W. R.
Splitdorf, C. F.

GLASS.
Lippincott Glass Co.

GLASS TUBES.
Lippincott Glass Co.

GLOBES, ARC LAMP.
Phœnix Glass Co.

GLOBES, SHADES, ETC.
American Reflector & Lighting Co.
Dale Company.
Frink, I. P.
Holophane Glass Co.
Kinsman Electric & Ry. Supply
National X-Ray Reflector Co.
Phœnix Glass Co.

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New Process Raw Hide Co.
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Hardinge Bros.

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GREASE.
Dixon Crucible Co., Jos.

HACK SAWS.
Smith, Hemenway & Co., Corp.

HANGER BOARD.
Ft. Wayne Electric Works.

HARD RUBBER, PERFORATED.
Aitchison Perforated Metal Co., Robert

HEATING APPARATUS.
Sturtevant Co., B. F.

Continued on Page 34.

TRANSFORMERS

For any voltage or frequency. High potential testing transformers.

Step up and step down transformers, for long distance transmission.

VENTILATED TYPE. OIL TYPE.

The Lakon Improved Hanger

THE LAKON COMPANY,
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DALE'S WIRELESS CLUSTER
With Switch Attached.

DALE'S Wireless Clusters

Patented April 19th, 1904. Multiple or Series.

YOUR LOSS If you have not seen them.
After you have seen them YOU WILL BUY them.

Cheaper than a CLUSTER requiring sockets.
Simpler and better than any other make on the market.
Passed by underwriters.
Can be installed instantly.

NOT NECESSARY TO REMOVE RINGS TO CONNECT UP.

NO porcelain base used—thus eliminating possibility of BREAKAGE.

Fastened to or suspended from ceiling WITHOUT use of tripod.

Packed ONE in a box—ABOUT HALF THE WEIGHT of other wireless clusters.

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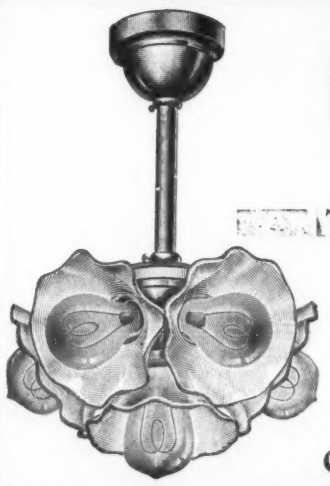
With Ceiling Flange and Shade Holder for Low Ceiling Work.



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WIRELESS CLUSTERS
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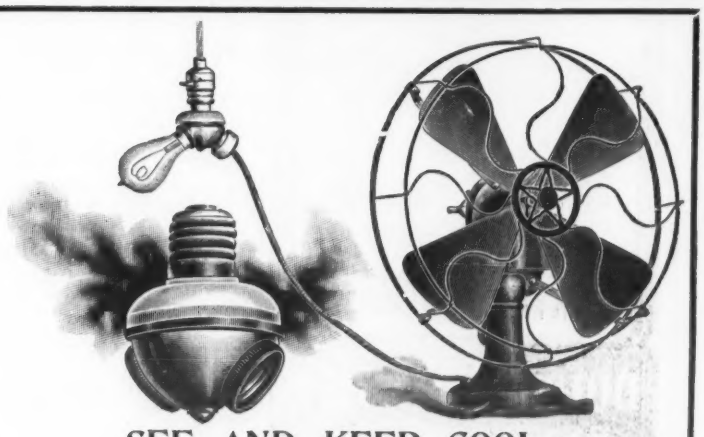
CHICAGO NEW YORK



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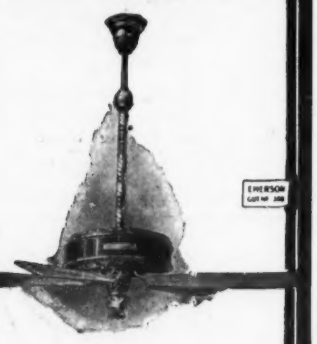
4-Blade Ceiling Fan



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HIGHEST GRADE
LOWEST PRICE
QUICKEST DELIVERIES

DOUBLEDAY-HILL ELECTRIC CO.
PITTSBURG, PA.

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HEATING BY EXHAUST STEAM.
American District Steam Co.

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Case Mfg. Co.
Jeffrey Mfg. Co.
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Muralt & Co.
Pawling & Harnischfeger.
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Pelton Water Wheel Co.

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Holtzer-Cabot Elec. Co.

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Splitdorf, C. F.
Varley Duplex Magnet Co.

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Blake Signal & Mfg. Co.

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American Insulated Wire & Cable Co.
American Vulcanized Fibre Co.
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Anderson Porcelain Co.
Bellevue Porcelain Works.
Bissell Co., F.
Calman Co., Emil.
Compressed Fibre Co.
Connolly Bros., Ltd.
Crescent Insulated Wire & Cable Co.
Delaware Hard Fibre Co.
Dielectric Mfg. Co.
Driver-Harris Wire Co.
Empire China Works.
Ft. Wayne Electric Works.
Hartford Faience Co.
Hemingray Glass Co.
Hope Webbing Co.
Imperial Porcelain Works.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Kruesi, P. J.
Locke Insulator Mfg. Co.
Magnet Wire Co.
Mica Insulator Co.
Murdock, H. D.
Munsell & Co., Eugene.
Mustard, John.
National Wire Corporation.
New England Butt Co.
Pass & Seymour, Inc. (China).
Ryle & Co., Wm. (Silk).
Safety Insulated Wire & Cable Co.
Scranton Button Co.
Siemon Hard Rubber Corporation.
Standard Paint Co.
Standard Underground Cable Co.
Standard Vitrified Conduit Co.
Sterling Varnish Co.
Steward Mfg. Co., D. M.
Sunlight Lava Mfg. Co.
Thomas & Sons, R.
Trenton Porcelain Co.
United Button Co.
Vulcanized Fibre Co.
Waterbury & Co.

JACKS.
Smith, Hemenway & Co., Corp.
Watson-Stillman Co.

JUNCTION BOXES.
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D. & W. Fuse Co.
General Incandescent Arc Light Co.
Johnson & Morton.
Sarco Company.

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Incan. Electric Lt. Manip. Co.

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Adams-Bagnall Elec. Co.
Allgemeine Elektricitats Gesellschaft.
American Electrical Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Bissell & Co., F.
British Thomson-Houston Co.
Brush Elec'l Engineering Co.
Doubleday-Hill Elec. Co.
Ft. Wayne Electric Works.
General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Helios Mfg. Co.
Keystone Electric & Mfg. Co.
Stanley Electric Mfg. Co.
Warner, W. F.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

LAMP BULBS.
Lippincott Glass Co.

LAMP COLORING COMPOUND.
Signaloid Chemical Wks.
Webster Chemical Co.

LAMP HOLDERS.
Crescent Co.

LAMPS, INCANDESCENT.
Crescent Co.

LAMPS, INCANDESCENT.
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Bissell Co., F.
Brilliant Electric Co.
British Thomson-Houston Co.
Brush Elec'l Engineering Co.
Bryan-Marsh Co.
Central Elec. Co.
Columbia Inc. Lamp Co.
Economical Electric Lamp Co.
Edison Dec. & Min. Lamp Co.
General Electric Co.
General Incandescent Arc Light Co.
Germania Elec. Lamp Co.
Machado & Roller.
Missouri American Elec. Co.
New York & Ohio Co.
Sawyer-Man Electric Co.
Standard Electrical Mfg. Co.
Sterling Elec'l Mfg. Co.
Tipless Lamp Co.
Western Electric Co.

LAMPS, MINIATURE.
American Endoscopic Co.
Edison Dec. & Min. Lamp Co.
Jaeger Min. Lamp Co.

LAMPS, NERNST.
Nernst Lamp Co.

LAMPS, REGULATING.
Economical Electric Lamp Co.

LAMP REPLACERS.
Incan. Electric Lt. Manip. Co.

LATHES.
Barnes Co., W. F. & John.
Garvin Mch. Co.
Hardinge Bros.
Sebastian Lathe Co.
Seneca Fall Mfg. Co.

LETTERS FOR ELECTRIC SIGNS.
Electric Motor & Equipment Co.
Haller Machine Co.
Western Display Co.

LINEMEN'S TOOLS.
Bissell Co., F.
Cincinnati Tool Co.
Klein & Son, Mathias.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

LIGHTNING ARRESTERS.
Cook, Frank B.
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Garton-Daniels Co.
Muralt & Co.
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Viaduct Mfg. Co.
Westinghouse Elec. & Mfg. Co.

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Lunkenheimer Co.

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Bement, Miles & Co.
Garvin Mch. Co.
Niles Tool Works Co.
Perkins Machine Co.
Pond Machine Tool Co.
Pratt & Whitney Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
Watson-Stillman Co.

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Electro-Dynamic Co.
Kilbourne & Clark Co.

MAST ARMS.
Brady, T. H.

MEDICAL APPARATUS.
Pignolet, Louis M.
Splitdorf, C. F.

METALS.
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Baker & Co., Inc.
Croselmire & Ackor.
Diamond Anti-Friction Metal Co.
Leslie & Co., A. C.
Phosphor Bronze Smelting Co.

METAL LETTERS.
Haller Machine Co.

METAL, PERFORATED.
Aitchison Perforated Metal Co., Robert.

METAL POLISH.
Allen Co., Inc., L. B.
Hoffman, George W.

MICA.
Johns-Manville Co., H. W.
Mica Insulator Co.
Munsell & Co., Eugene.
Schoonmaker, A. O.
Sills-Eddy Mica Co.
Vance, D. T.

MILLING MACHINES.
Niles Tool Works Co.
Pratt & Whitney Co.

MINING MACHINERY.
General Electric Co.
Jeffrey Mfg. Co.
Muralt & Co.
Power & Mining Machinery Co.

MODEL MAKERS.
Baillard, E. V.
International Brass & Electric Co., Inc.
Parsell & Weed.

MOTOR CLOTH AND INSULATING PAPERS.
Standard Paint Co.

MOULDING.
K. & B. Company.

NAME PLATES.
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New York Steel & Copper Plate Co.

NIPPERS AND PLYERS.
Cincinnati Tool Co.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

NON-MAGNETIC WATCHES.
Becken, A. C.

NOZZLES.
McCullough-Dalzell Crucible Co.

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NUMBERING AND DATING MACHINES.
Bates Machine Co.

NUTS.
International Brass & Elec. Co.
National Acme Mfg. Co.

OIL.
Kellogg & Co., E. H.

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Bay State Stamping Co.
Crane Co.
Lunkenheimer Co.

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United Telpherage Co.

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Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.

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Mustard, John.
Standard Paint Co.
Sterling Varnish Co.

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Dyer & Dyer.
Goepel & Niles.
Rosenbaum & Stockbridge.
Townsend & Decker.

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Electrical Testing Laboratories.

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Phosphor Bronze Smelting Co.

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PLUGS.
Paiste Co., H. T.

PLUMBAGO.
McCullough-Dalzell Crucible Co.

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Bissell Co., F.
Brady, T. H.
Eastern Arm & Pin Co.
Eccleston Lumber Co.
K & B Company.
Kellogg S. B. & Supply Co.
Lindsley Bros. & Co.
Phelan, D. W.
Porter Cedar Co.
Sterling & Son, W. C.
Strock, S. C.
Valentine-Clark Co.
Va. Locust Pin Co.
Worcester Co., C. H.

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Anderson Porcelain Co.
Bellevue Porcelain Works.
Empire China Works.
Hartford Faience Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Mustard, John.
Pass & Seymour, Inc.
Thomas & Sons, R.
Trenton Porcelain Co.

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Jeffrey Mfg. Co.
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Link-Belt Engineering Co.
Mead-Morrison Mfg. Co.
Muralt & Co.
Niles Tool Works Co.

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Perkins Machine Co.
Pond Machine Tool Co.
Watson-Stillman Co.

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Jeffrey Mfg. Co.
Niles Tool Works Co.
Smith Co., S. Morgan.

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Commercial Electric Co.
Emerson Elec. Mfg. Co.
Quimby, Wm. E.

PUMPS, OIL.
Lunkenheimer Co.

PUMPS, STEAM.
McGowan Co., J. H.
Quimby, Wm. E.

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Sarco Company.

You've often wished

for just the improvements embodied in

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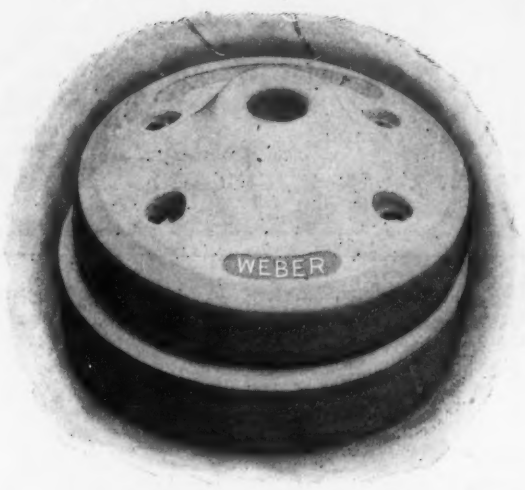

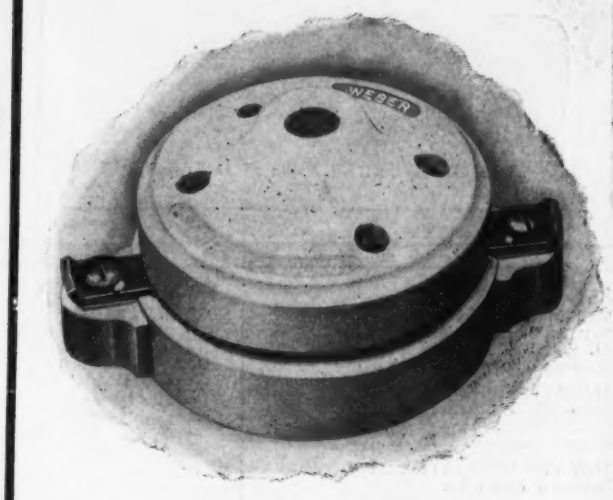

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Short circuiting impossible.

Covers are easily fastened to and removed from bases by a quarter turn—no screwdriver necessary—they are securely locked in position and cannot shake loose. Covers of all styles are interchangeable.

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Electrical Glassware

Inner and Outer Globes for Arc Lamps
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Incandescent Lamp Bulbs
Glass in Any Color—Etching or Frosting
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Alexandria, Indiana

Type C indicating Fuse before blowing!

Type C indicating Fuse after blowing

It is Unreasonable

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Central Electric Company,

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OKONITE IT NEVER DISAPPOINTS

CLASSIFIED INDEX—*Continued from Page 34.*

Pond Machine Tool Co.
Pratt & Whitney Co.

RAIL BONDS.
Roebling's Sons Co., J. A.

RAILWAY SUPPLIES (Electric).
Brush Elec'l Engineering Co.
General Elec. Co.
Johns-Manville Co., H. W.

RAILWAYS (MINIATURE).
Carlisle & Finch Co.

RIVETED STEEL PIPE.
Pollock Co., Wm. B.

RAW HIDE PINIONS.
New Process Raw Hide Co.

RECEPTACLES.
Benjamin Elec. Mfg. Co.
Dale Company.
Electro Dynamic Co.
General Incandescent Arc Light Co.
Paiste Co., H. T.
Trumbull Elec. Mfg. Co.

REFLECTORS.
American Reflector & Lighting Co.
Dale Company.
Frink, I. P.
Holophane Glass Co.
National X-Ray Reflector Co.
Phœnix Glass Co.
Sarco Company.
Sunlight Reflector Co.

REFRIGERATING MACHINERY.
Vilter Mfg. Co.

REPAIRING.
Chicago Edison Co.
Elliott Bros. Elec. Co.
Gregory Electric Co.
Heck, Louis.
Northwestern Electric Co.

RHEOSTATS.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
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Ward Leonard Electric Co.
Wirt Electric Co.

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Jeffrey Mfg. Co.

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Hart Mfg. Co.
Pass & Seymour, Inc.
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Allen Co., L. B.
Klipstein & Co., A.
Roessler & Hasslacher Chem. Co.

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Richardson Scale Co.

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American School of Correspondence.
Electrical Engineer Inst. of Correspondence Inst.
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Rose Polytechnic Institute.

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National-Acme Mfg. Co.

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Bogue, Charles J.
Carlisle & Finch Co.
Ft. Wayne Electric Works.
Rushmore Dynamo Works.

SECOND-HAND APPARATUS.
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Bissell & Co., F.
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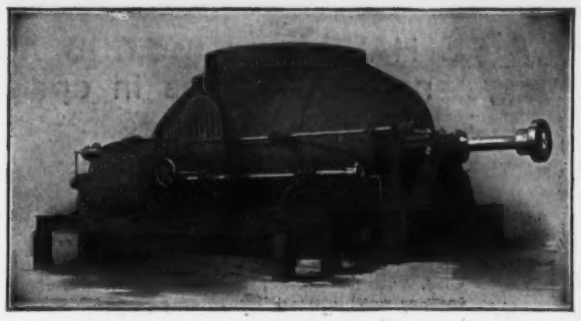

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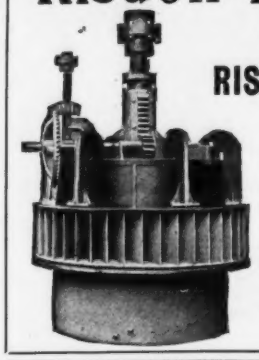

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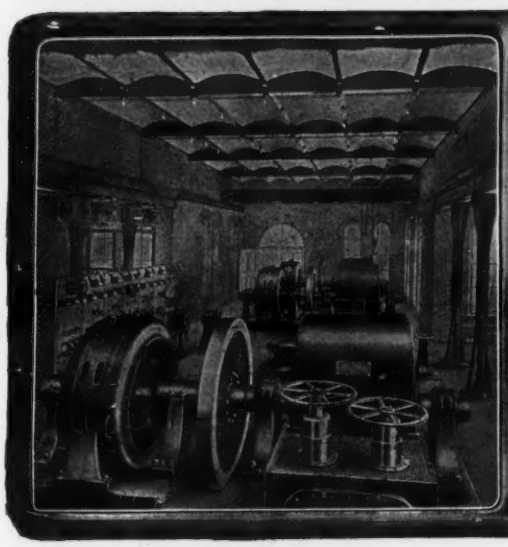
SUBSCRIBERS and ADVERTISERS Will confer a favor upon us by notifying us promptly in case ELECTRICAL WORLD AND ENGINEER does not reach them every week.



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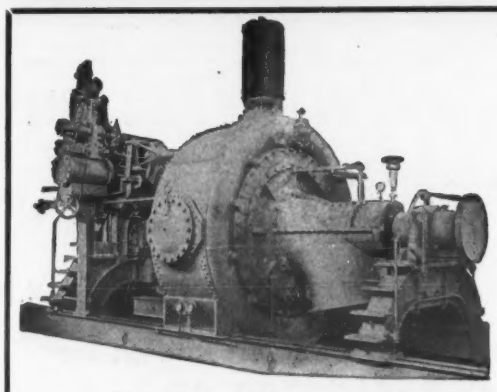

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The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us, for the NIAGARA FALLS HYDRAULIC POWER & MFG. CO., Niagara Falls, N. Y. Tests conducted by competent engineers developed as follows:

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213 ft.	½	257 r.p.m.	1750	95%	.730%
213 "	¾	257 "	3000	95%	.856%
213 "	Full	257 "	3500	95%	.815%

These results have never been equalled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made AFTER TURBINES WERE INSTALLED, direct coupled to Generators. Francis' weirs and formulæ for discharge were used. The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES. Note especially the UNIFORM SPEED at ALL GATEAGES.

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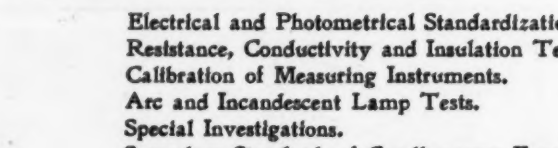

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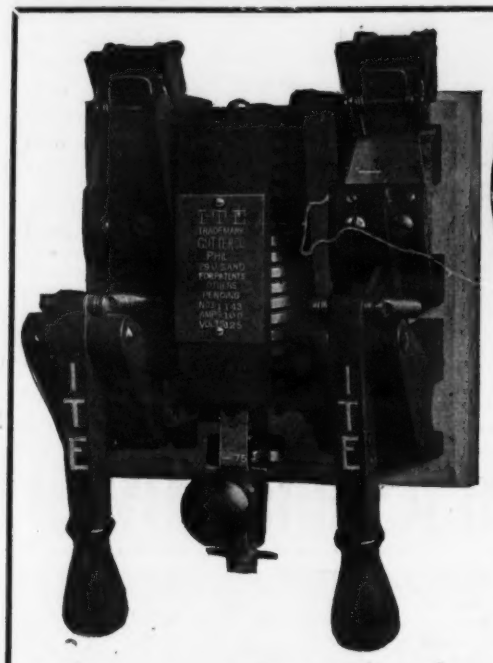

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A Correspondent of Electrical World & Engineer writes: "It is far superior to all electrical papers published."

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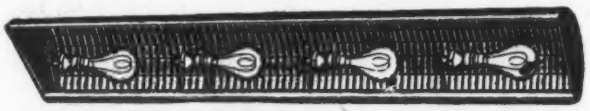

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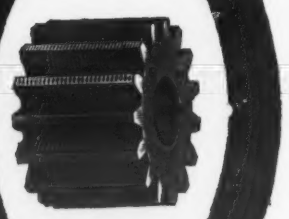
PROMPT DELIVERIES.
261-287 Devonshire St. and 4-5 Winthrop Square BOSTON.



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The New Process Raw Hide Company,
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The only article that will **prevent sparking.** Will keep the commutator in **good condition** and **prevent cutting.** Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after.

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They may still have a partial knowledge; but unless you

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it does not take very long to be forgotten.

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1	1500	West., 75-K.W.
1	1500	West., 75-K.W., 2 ph., 2200 v., d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Wood, 75-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
2	3000	Warren, 150-K.W.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES

Lt.		
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	900	Warren-Medberry, 45-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1500	Stanley, inductor, 75-K.W.
1	2400	Gen. Elec., 120-K.W., A 120.
2	2400	Gen. Elec., 120-K.W., A.S.120.
2	3000	Stanley inductor, 150-K.W.
1	4000	Westinghouse, 240-K.W.

110 TO 125 VOLT GENERATORS (COMPOUND.)

DIRECT CURRENT.

Lt.		
2	35	Hobart, Multipolar.
1	45	Lundell.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
2	50	Northern, Multipolar.
1	50	Westinghouse, Multipolar.
2	60	Hobart, Multipolar.
1	80	Fort Wayne, Multipolar.
1	80	Crocker-Wheeler.
1	80	Riker, Multipolar.
1	80	Perrett, Multipolar.
1	100	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Edison.
1	150	Eddy, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	160	Triumph, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	300	Phoenix, Multipolar.
1	300	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	300	Gen. Electric, Multipolar.
1	300	Western Elec., Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Edison, 25-K.W.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
1	540	Edison, 30-K.W.
1	540	C. & C., 30-K.W.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine.
2	700	Commercial, Multipolar.
1	700	Card, Multipolar.
1	700	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
1	1350	Waddel-Entz, 80-K.W., d. c. to Armington & Sims 15½x14 engine.
1	1350	Ft. Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp. 11x17x12 automatic engine.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
1	2200	Western Electric, Multipolar, 125-K.W., 6 pole.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

220 TO 250 VOLTS COMPOUND GENERATORS.

K.W.	
1	7½ Holtzer-Cabot.
1	9 New England, Multipolar.
2	10 T.-H.
1	12 Western Elec., Multipolar.
1	17½ Kester.
1	17½ Eddy.
1	20 Western Electric.
1	20 Keystone, Multipolar.
1	20 Eddy, Multipolar.
2	20 Western Elec., Multipolar.
2	30 C. & C.
1	40 C. & C., Multipolar.
1	40 Eddy, Multipolar.
1	45 Edison.
1	45 Am. Engine Co., Multipolar.
1	45 Western Elec., Multipolar.
1	45 C. & C., Multipolar.
1	45 Gen. Elec., Multipolar.
1	50 C. & C.
1	50 Commercial, Multipolar.
1	50 Maine, Multipolar.
1	55 Fuller, Multipolar.
1	55 Eddy, Multipolar.
1	60 Northern, Multipolar.
1	75 Siemens & Halske, Churchward type, Multipolar, direct connected to 14x14 Ideal engine.
1	80 C. & C.
1	100 Commercial, Multipolar.
1	125 Eddy, Multipolar.
1	150 National, Multipolar.
1	200 Eddy, Multipolar.
1	200 Westinghouse, Multipolar.
1	250 Western Elec., 6 pole.
1	300 Western Elec., Multipolar

500 TO 550 VOLT COMPOUND GENERATORS.

K.W.	
1	60 Edison.
1	62 T-H.
1	75 Akron, 6 pole.
2	75 General Electric.
1	100 Siemens & Halske, 4 pole.
2	100 Edison.
1	100 Gen. Elec.
2	120 Westinghouse.
1	200 Thompson-Ryan.
1	200 General Electric.

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNITS
Dynamo Engine

50-K.W. 220 V. American Ball.
42-K.W. 220 V. Westinghouse, Alfrey.
30-K.W. 220 V. Gen. Elec. Arm. Sims.
50-K.W. 110 V. Eddy, Ames.
37-K.W. 110 V. West., Erie Ball.
30-K.W. 110 V. Westinghouse, Ames.
8-K.W. 110 V. Crocker-Wheeler, Case.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

85-K.W. Gen. Electric, M. P.
75-K.W. Gen. Electric, M. P.
45-K.W. General Electric.
15-K.W. Eddy, M. P.
7½-H.P. Gen. Elec., Type C E.
5-H.P. Gen. Elec., Type C E.
3-H.P. Gen. Elec., Type C E.
1-H.P. C. & C.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

150-K.W. Westinghouse.
75-K.W. Westinghouse.
55-K.W. Gen. Elec., M. P.
45-K.W. Edison.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. Holtzer-Cabot.
7½-H.P. Edison.
5-H.P. Diehl.
2-H.P. Diehl.

500 VOLTS DIRECT CURRENT

100-K.W. General Electric, M. P.
75-K.W. Westinghouse, M. P.
5-H.P. Sprague.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

40-H.P. Type C Westinghouse.
30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.

2 Phase, 440 Volts, 60 Cycles

100-H.P. Westinghouse.
40-H.P. Westinghouse.
30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
5-H.P. Gen. Elec., 220 volts.
5-H.P. Gen. Elec., 110 V.
3-H.P. Westinghouse, 110 or 220 V.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Electric, 220 volts.

1 Phase, 60 Cycles

½-H.P. Wagner.
½-H.P. General Elec.

1 Phase, 125 Cycles

5-H. P. Wagner, 110 volts.
1-H.P. General Electric.
¼-H.P. Emerson.

Large stock of small motors, auto-starters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

I BUY, RENT AND INSTALL.—GEORGE BENDER, 137 CENTRE STREET, NEW YORK.

CRESCENT COMPANY CHICAGO

CRESCENT SOLDERING STICKS AND CRESCENT SOLDERING PASTE

ARE MADE BY PRACTICAL MEN

with selected materials that are thoroughly tested in laboratory before using. These methods insure a perfect Soldering Flux that does no injury to wire or insulation

ASK YOUR DEALER FOR THEM OR MAIL 75c. FOR SAMPLE HALF DOZEN

MAY 2, 1904.

CRESCENT COMPANY, Chicago.

Gentlemen: Our foreman reports very favorably on your sample of Crescent Soldering Paste, and you may send us twenty-five pounds in one pound boxes at your earliest convenience.

Very truly yours,
KOHLER BROTHERS.

BARGAINS

GREGORY ELECTRIC CO.

54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock.

ARC DYNAMOS.

	Lt.	C.P.	
1	35	2000	T.-H., L D 2 ball.
1	50	1200	T.-H., L D 12, new ball.
2	50	2000	T.-H., M. D 2, s-o., ring.
1	75	1200	T.-H., M D 12 s-o.
1	75	1200	Wood.
1	125	1200	Excelsior.

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.
1	1	General Electric, type I B.
1	2	Lundell.
1	2½	Riker.
1	3	C. & C.
1	3	Bernard, Multipolar.
1	3	Gibbs, Multipolar.
1	3	Lundell.
3	3	Western Electric, Multipolar.
3	3	Westinghouse, Multipolar.
1	3½	Eddy, Multipolar.
1	4	Commercial, Multipolar.
2	5	Gibbs, Multipolar.
3	5	Hobart, Multipolar.
5	5	Western Electric, Multipolar.
1	5	Eddy, Multipolar.
3	5	Belknap, Multipolar.
2	5	Crocker-Wheeler special printing press motors, direct con.
1	6½	Jenney, Multipolar, back geared.
1	7½	Edison.
2	7½	Western Electric, Multipolar.
1	7½	Milwaukee, Multipolar, series.
1	8	Holtzer-Cabot.
1	8	Crocker-Wheeler, series.
1	8	Maine, Multipolar.
1	10	Standard, Multipolar.
1	10	C. & C., Multipolar.
1	10	Keystone, Multipolar.
1	10	Western Electric, Multipolar.
2	10	Westinghouse, Multipolar.
3	10	Bernard, Multipolar.
1	15	Keystone, Multipolar.
1	15	New England, Multipolar.
1	15	Western Electric, Multipolar.
1	18	Edison, 15-K.W.
1	20	Eddy.
1	20	Kester.
2	25	Edison.
1	25	Western Electric.
1	25	Keystone, Multipolar.
1	25	Eddy, Multipolar.
1	25	Western Electric, Multipolar.
2	40	C. & C.
1	40	Sprague-Lundell, Multipolar.
1	50	C. & C., Multipolar.

	H.P.	
1	50	Eddy, Multipolar.
1	50	Am. Engine Co., Multipolar.
1	60	C. & C.
1	60	Edison.
1	60	Commercial, Multipolar.
1	60	C. & C., Multipolar.
1	60	Maine, Multipolar.
1	60	Western Electric, Multipolar.
1	60	General Electric, Multipolar.
1	65	Eddy, Multipolar.
1	70	Fuller, Multipolar.
1	75	Northern, Multipolar.
1	85	Western Electric.
1	100	C. & C.
1	125	Edison.
1	135	Commercial, Multipolar.
1	150	Eddy, Multipolar.
2	200	National, Multipolar.

500 TO 550 VOLT MOTORS.

	H.P.	
1	1	General Electric.
2	1½	Northern, series.
2	1½	Crocker-Wheeler.
1	2½	New England.
1	3	C. & C.
1	3	General Electric.
1	3	Jenney, Multipolar.
1	3½	Westinghouse, Multipolar.
1	4	Edison.
1	4	Bernard, Multipolar.
1	5	Fort Wayne.
2	5	Triumph, Multipolar.
3	5	Crocker-Wheeler.
1	6	C. & C., enclosed.
1	7½	Card, Multipolar.
1	7½	Jenney, Multipolar.

	H.P.	
1	7½	C. & C., Multipolar.
3	7½	Crocker-Wheeler.
1	7½	Eddy, Multipolar.
1	10	Phoenix, Multipolar.
1	10	Crocker-Wheeler.
1	10	Northern, Multipolar.
1	10	Triumph, Multipolar.
2	10	General Elec., Multipolar.
1	10	Perrett, Multipolar.
1	10	Eddy, Multipolar.
3	10	Belknap, Multipolar.
1	12	Am. Engine Co., Multipolar.
1	15	Eddy.
1	15	C. & C.
1	15	Edison.
1	15	Perrett, Multipolar.
1	15	Maine, Multipolar.
1	20	Eddy.
1	20	Perrett, Multipolar.
1	20	Holtzer-Cabot, Multipolar, enclosed.

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.	
2	½	Stanley, 110 volts.
1	½	Holtzer-Cabot, 104 volts.
1	½	Emerson, 104 volts.
1	½	Wagner, 104 volts, automatic.
1	1	Fort Wayne, 104 volts.
1	1	Wagner, 208 volts, automatic.
1	1½	Wagner, 208 volts, automatic.
1	3½	Wagner, 110 volts, automatic.

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.	
1	3	General Electric, 110 volts.

SINGLE PHASE. 60 CYCLES.

	H.P.	
1	½	General Electric, 110 v.
1	1	Phillips, 208 volts.
1	1	Phillips, 104 volts.
1	2	Wagner, 208 volts, automatic.
1	2	Wagner, 104 volts.
1	3	Wagner, 208 volts, automatic.
1	30	Wagner, 104 volts, automatic.

TWO PHASE. 60 CYCLE.

	H.P.	
1	2	General Electric, 220 volts.
1	5	Westinghouse, 220 volts.
1	50	Westinghouse, 400 v.
2	100	Westinghouse, 400 v.

THREE PHASE. 60 CYCLE.

	H.P.	
2	1	General Electric, 110 volts.
1	2	General Electric, 110 volts.
2	2	General Electric, 220 volts.
1	5	Gen. Elec., 110 volts.
1	10	Gen. Elec., 110 volts.
1	15	Gen. Elec., 110 v.
1	30	Gen. Elec., 110 v.

ELECTRIC LOCOMOTIVES.

	Ton.	
1	10	Morgan-Gardner, type M, 250 v. direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour.
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour.

FOR SALE.

DIRECT CONNECTED.

30-K.W. Eddy dynamo to Watertown engine, 110 volts.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

BELTED.

60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.

These motors are dust proof and series wound.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

JORDAN BROS., 74 Beekman St., N. Y.

LOUIS HECK,

Successor to STUCKY & HECK, ELECTRICAL MANUFACTURING CO., Lit'd.

Electrical and Mechanical Engineers and Draughtsman

Every System—Repairing, Re-winding, Re-construction

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35 N. J. RAILROAD AVE., Opp. Market St. Railroad Depot, NEWARK, N. J.

To the Point

FOR BARGAINS OF DISTINCTLY BETTER QUALITY

4—75 K.W. G. E. 125 Volt M. P. Generators.
2—130 K.W. 2340 Volt A. C. General Electric.
2—120 K.W. 2340 Volt A 60 General Electric.
2—120 K.W. 2340 Volt A 70 General Electric.
2—3 circuit, 125 Light, 9.6 ampere brush arc dynamos.
800 M 2 double T. H. open arc dynamos.
200 M 2 single T. H. open arc dynamos.

500 VOLT.

1—500 K.W. G. E. M. P. type.
1—225 K.W. G. E. M. P. type.
2—375 K.W. Westinghouse direct connected.
1—225 K.W. Westinghouse direct connected.

ENGINES.

2—750 H.P. Allias to Cross Compound.
2—500 H.P. Ball Cross Compound.
1—1500 H.P. Pa. Iron Works.

FAN MOTORS.

350 Ceiling Fans, 110 Volt, various makes and finish, all in good order.

We solicit correspondence from parties having steam, electrical or pumping plants, desiring something larger or more improved.

Machinery of all kinds bought, sold and exchanged.

THOMPSON-BONNEY CO.
45 York St., BROOKLYN, N. Y.

PROPOSALS FOR LIGHTING

Notice is hereby given that sealed proposals will be received by the Light and Water Committee of Councils of the City of Williamsport, Pennsylvania, till 12 o'clock noon of Friday, July 29, A. D. 1904, for the lighting of the streets of Williamsport with the most modern system of electric lighting, every night and all night for a period of five years, also for a period of ten years, from December 1, 1904; ALSO bids for lighting the City Hall and the several Fire Engine Houses of the City for similar periods. Bids for Street Lighting to state the kind and number of lights to be furnished, the system of lighting, the candle power and distribution of lights. Bids to be accompanied by a certified check in the sum of Five Thousand Dollars ($5,000.00), upon one of the banks of Williamsport, said amount to be forfeited as liquidated damages in case the successful bidder fails to execute contract and furnish the required bond. The City reserves the right to reject any or all bids. Bids are to be sent to the City Clerk, endorsed "PROPOSALS FOR ELECTRIC LIGHTING." The successful bidder shall have the privilege of erecting poles, wires, etc., for the purpose of furnishing lights for the streets of the City, the Fire Engine Houses and City Hall, as well as for commercial purposes, under such regulations as Councils may by ordinance provide. All information in regard to number of lights, location of same, etc., can be obtained of the City Clerk, Williamsport, Pa.

J. J. GALBRAITH, City Clerk
A. F. YOUNG, Chairman of Light and Water Committee

Dynamo and Motor Repairing

Armature Winding, Armature Coils. Commutators, Gears and Pinions.

Our Specialty **Railway Field Coils** of Every Type

The ELLIOTT BROS. ELECTRIC CO.
Cleveland, O.

COPPER COILS CAN'T CORRODE

if treated with

A permanently plastic coil cement

DIELECTROL

DIELECTRIC MNFG. CO., SAINT LOUIS

WANTED TO BUY

Electric Light Plant in town of over 15,000 inhabitants. We also have a purchaser for a combination gas and electric plant in town of over 10,000 inhabitants. Describe fully, stating equipment and prices.

CENTRAL STATION ENGINEERING CO.
Old Colony Bldg., Chicago

FOR SALE: In Alabama.

2—A-6 Thomson-Houston Alternators, single phase, 1100 volt, 125 cycle, slotted type armature.
1—Extra armature for above.
1—Thomson-Houston M-12 arc dynamo.
1—Thomson-Houston L. D.-12 arc dynamo.
1—L. D.-12 armature.
1—14"x16" McEwen High Speed Automatic Engine.
1—Westinghouse alternator, 75-K.W., 60 cycle, 2200 volt, single phase.

Address
Henry S. Fleming, 1 Broadway, New York City

FOR SALE

1—150-K.W. 60 cycle 1040 volt G. E. monocyclic alternator, A-1 condition, $1000, f.o.b.
1—12x12 Erie Ball Engine, fine condition, $300, f.o.b. Address

No. 1521,
care Electrical World and Engineer New York

FOR SALE

Well-established electrical supply business in western metropolis. Annual sales $150,000. Address

No. 1513,
care Electrical World and Engineer, New York

BARGAIN SALE

1—600-H.P. Tandem Compound Horizontal Engine and 400-K.W. Generator from factory of recognized high-class builders, generator direct connected to Engine. Neither Engine nor Generator are yet built. Will sell Engine or Generator separate and arrange to suit any other Engine or Generator to suit purchaser. Generator can be A. C. any phase or voltage or D. C. any voltage. Will sell for $1000 less than cost. Address No. 1509, care Electrical World and Engineer, New York.

FOR SALE

Two 250 K.W., 10,000 volt generators.

General Electric, three-phase, 60 cycle, revolving field type, belted machines with exciters and marble switchboard.

Portland Lighting & Power Co.
Portland, Maine

North, South, East, West, at home and abroad,
ELECTRICAL WORLD AND ENGINEER
is recognized as the leading electrical journal, and is therefore the one which is consulted when purchasing is to be done.
It has no geographical limitations.

RAILWAY GENERATORS

2—500-K.W. General Electric Railway Generator.
1—400-K.W. General Electric Railway Generator, direct connected.
3—200-K.W. Edison Bi-polar Railway Generator, prime condition.
2—200-K.W. Westinghouse 6 pole Railway Generator.
1—150-K.W. General Electric 6 pole Railway Generator.

60-CYCLE ALTERNATORS

1—700-K.W. 60 cycle, three phase Westinghouse, three bearing.
1—300-K.W. 60 cycle, General Electric, direct connected.
2—250-K.W. 60 cycle, General Electric, 3 phase, type A. T. B.
1—150-K.W. 60 cycle, General Electric, monocyclic.
1—120-K.W. 60 cycle, Westinghouse, 2 phase.
3—120-K.W. 60 cycle, General Electric, single phase.
1—100-K.W. 60 cycle, General Electric, three phase.
1—75-K.W. 60 cycle, Ft. Wayne Wood, single phase.

133 Cycle

1—300-K.W. Stanley, 2 phase.
3—150-K.W. Ft. Wayne Wood, single phase.
2—120-K.W. General Electric, single phase.

DIRECT CURRENT.

2—200-K.W. Edison Bi-polars, 250 volts, compound-wound.
1—100-K.W. 8 pole General Electric, 125 volts, direct connected to 15½ x16 New York Safety Engine.
1—100-K.W. 6 pole Western Electric, 125 volts, direct connected to 16x16 Ideal, latest type.
175-K.W. and 100-K.W. Edison Bi-polars.
1—160-Light Ft. Wayne Wood Arc Machine.

We list no Engines here, but will send list of Engines, Corliss and Automatic, simple or compound, of all types, upon request. Write what you want.

STATION EQUIPMENT COMPANY, 204 DEARBORN ST. CHICAGO.

STREET RAILWAY FRANCHISE.

THE MUNICIPAL COUNCIL OF THE FOREIGN SETTLEMENTS AT SHANGHAI, CHINA, hereby invites tenders for a concession for constructing and operating about 23 miles of Electric Tramways on the "Trolley System" in the streets of Shanghai.

Further information may be obtained upon application to Messrs. Fearon, Daniel & Co., Agents for the Council, 96 Wall Street, New York City, or by addressing Mr. Charles Mayne, Municipal Engineer, Shanghai, China.

Sealed tenders indorsed "Tender for Tramway Concession" should be addressed to J. O. P. Bland, Secretary of the Municipal Council, Shanghai, China.

If you want to do business with any man in the electrical field in any part of the world, the right medium to advertise in is ELECTRICAL WORLD AND ENGINEER.

SWITCH BOARD CHEAP

9 panels of blue Vermont marble, 90" high by 28" wide and 2" thick in two parts. Top panel 65" high, sub-base 25" high. Six of these panels are designed for 4 wire 3 phase Feeder panels, each one mounting 1 Elden Automatic Oil Circuit Breaker, 4 pole, 100 ampere, 4500 volt 4 single pole S. T. knife switches with marble barriers, 100 amperes, 4500 volts.

3 Wagner Ammeters; 80 ampere with current transformers.

1 Mershon Volt meter Compensator arranged to plug on either phase.

3 Goose Neck Ills lamp brackets.

1 panel containing 1-10 ampere Ammeter with current transformer.

2 primary plug switches for arc circuit 10 ampere 5000 volts.

1 panel containing 2 Elden Auto oil circuit breakers, 200 ampere 4500 volts, 3 pole.

2 hand operated 3 pole S. T. oil switches, 100 ampere 4500 volts Elden make.

1 total load panel mounting. 1 Elden Auto oil circuit breaker 100 ampere, 4 pole, 4500 volt. 1 4 pole knife switch, 150 ampere, 4500 volts with marble barriers. 3 Wagner Ammeters 150 ampere with current transformers. 3 Stanley Recording Primary Wattmeters, 200 ampere.

Also one Swing bracket mounting 2 Wagner Volt meters, 150 volt with potential transformer. One arranged to be used with compensators and one to read Buss bar voltage.

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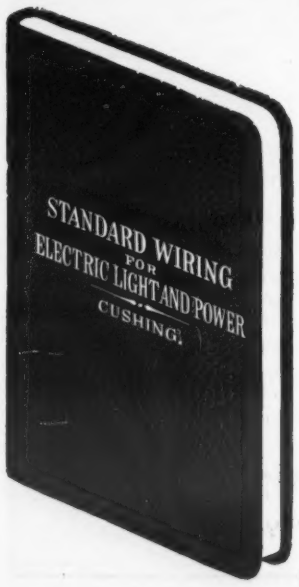

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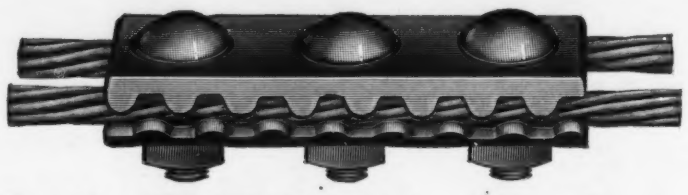

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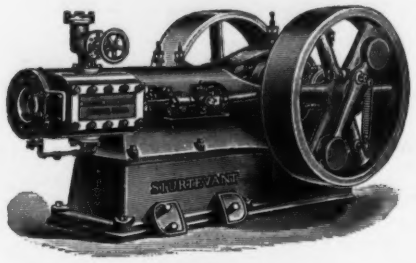

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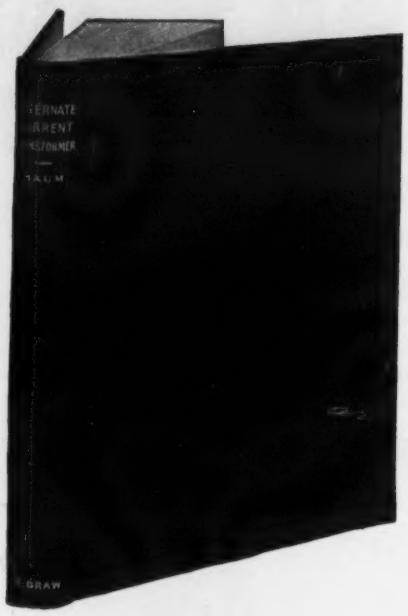

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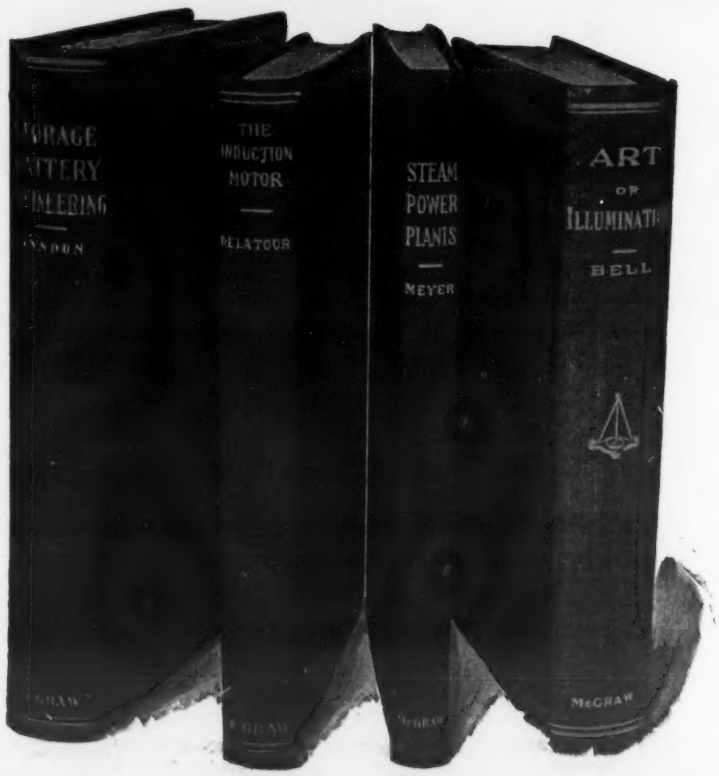

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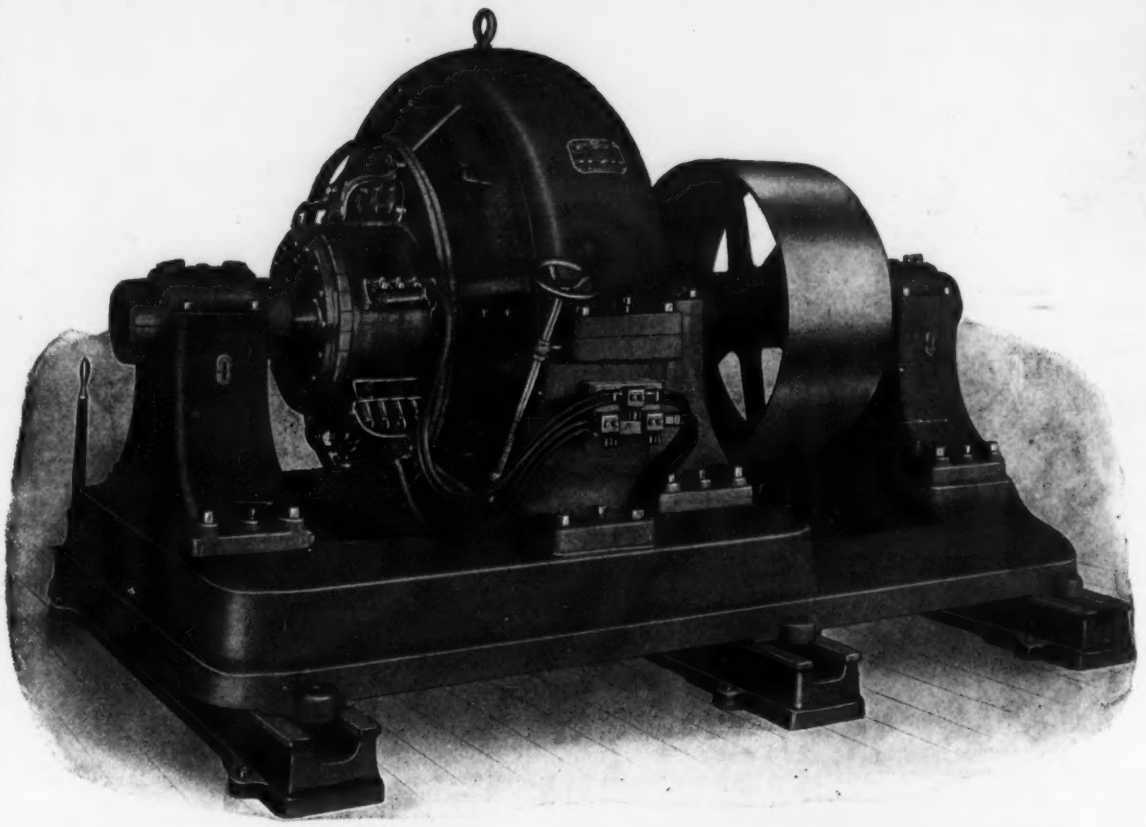

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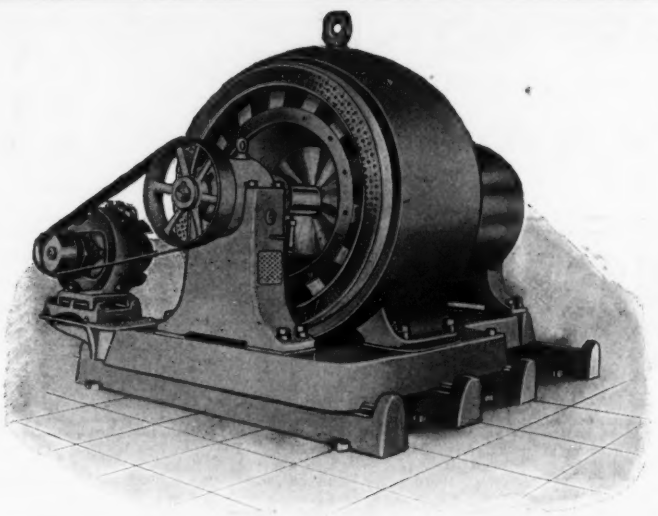

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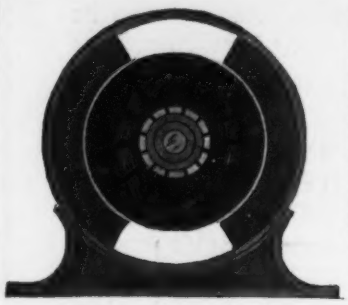

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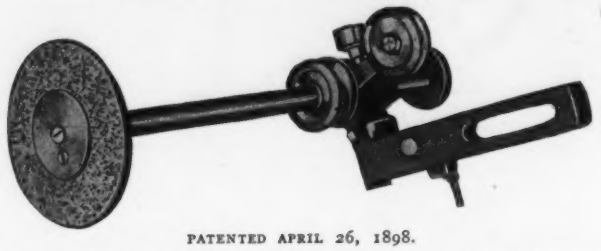

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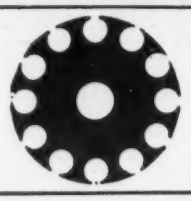

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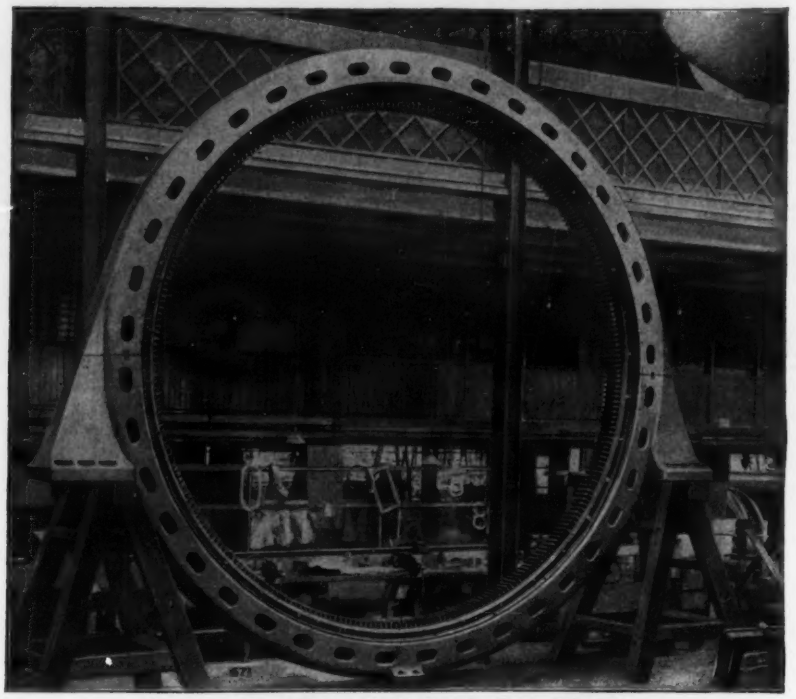

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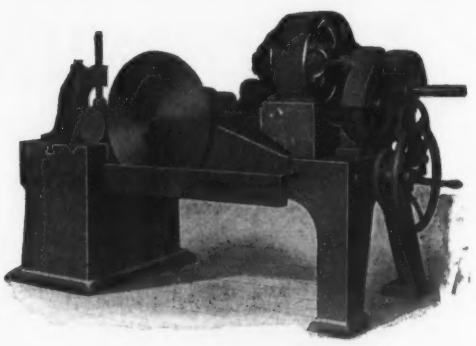

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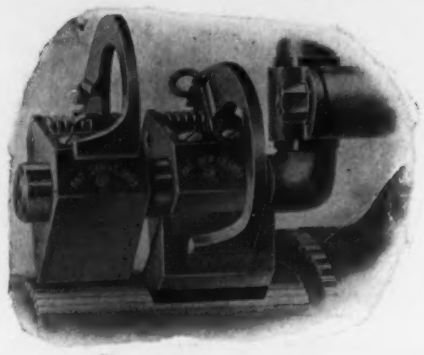

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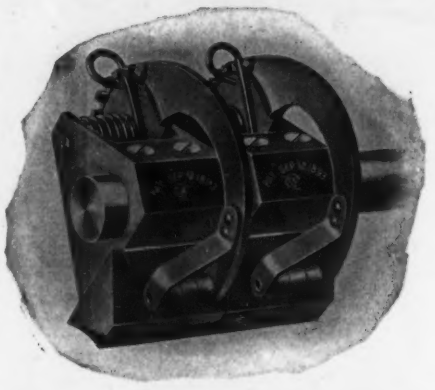

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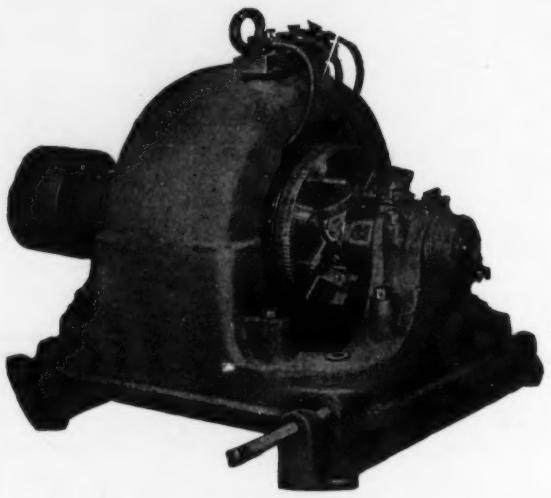

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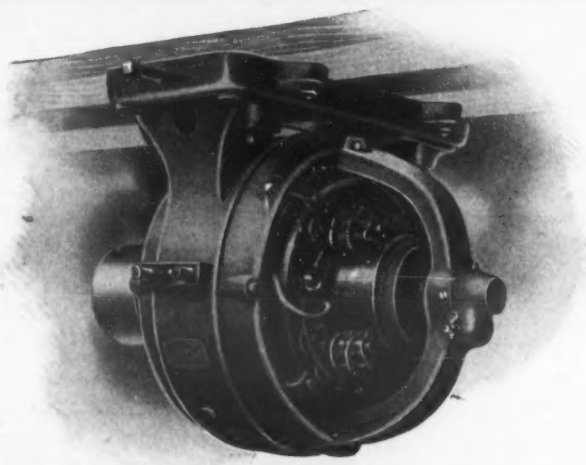

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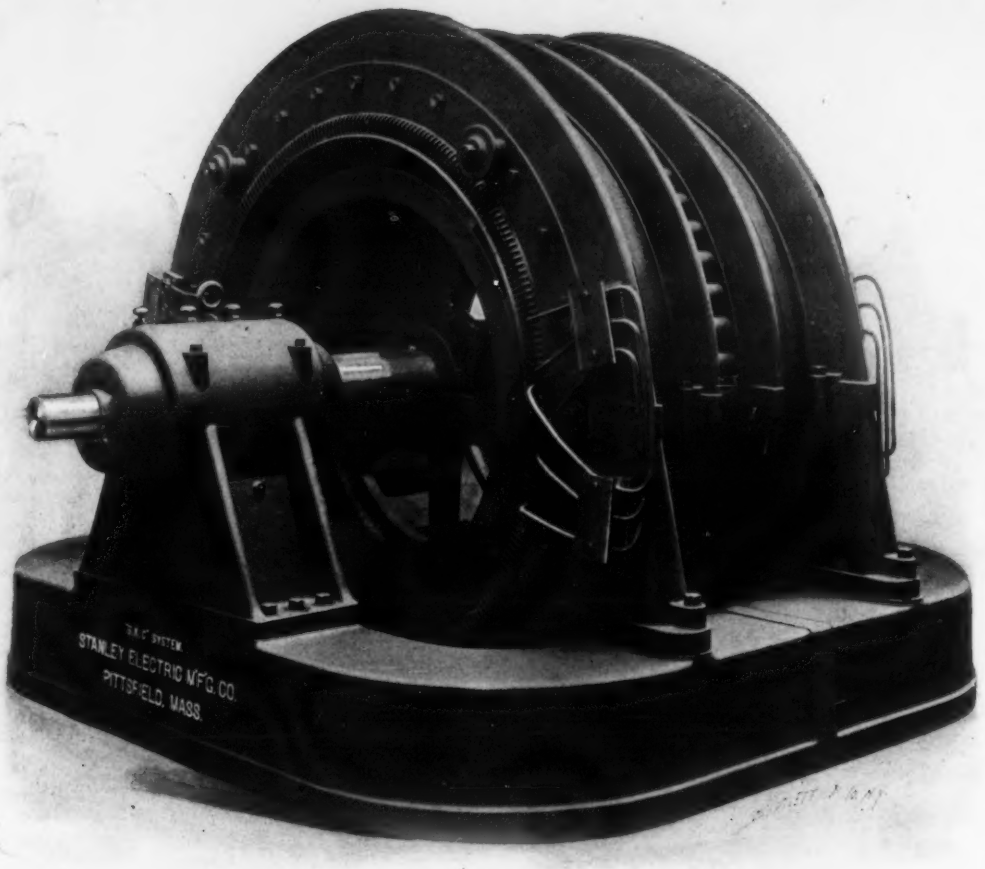

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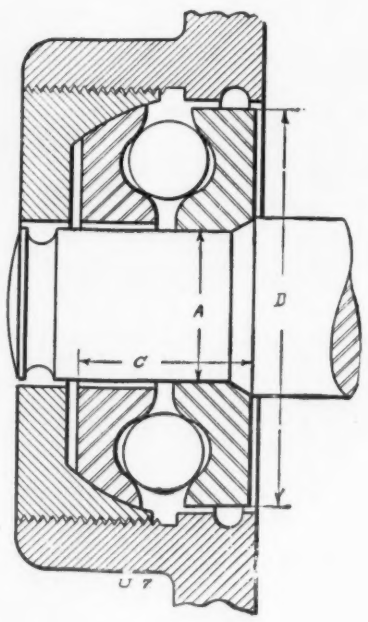

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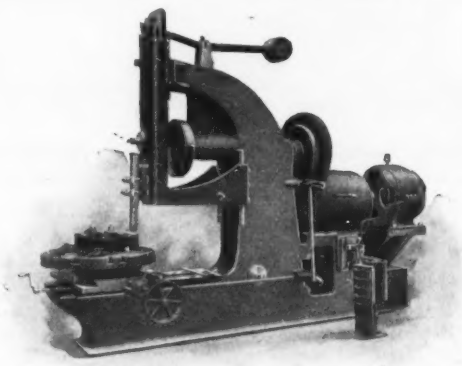

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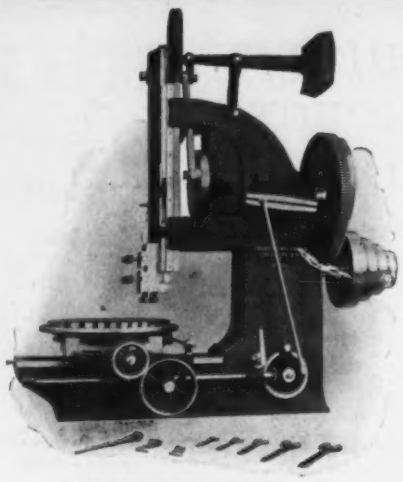

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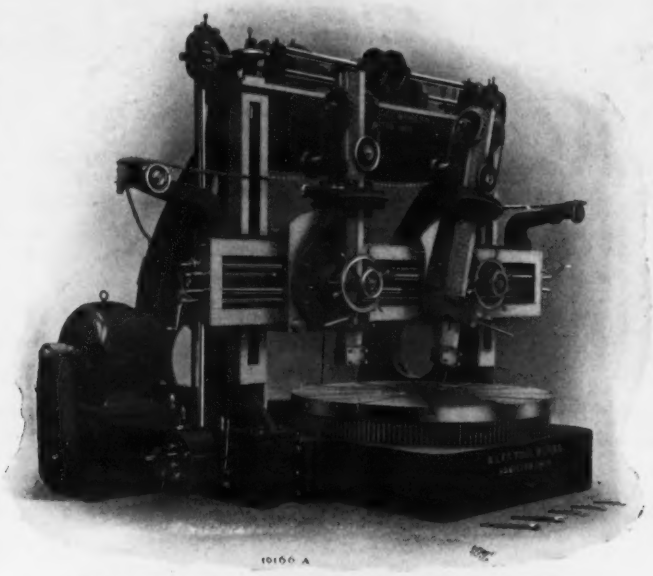

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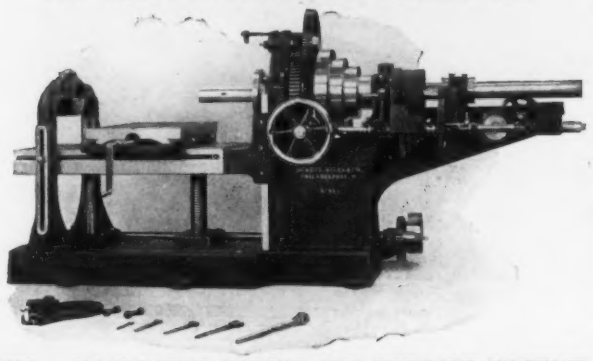

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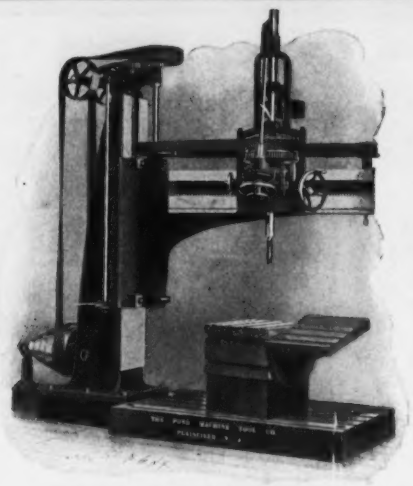

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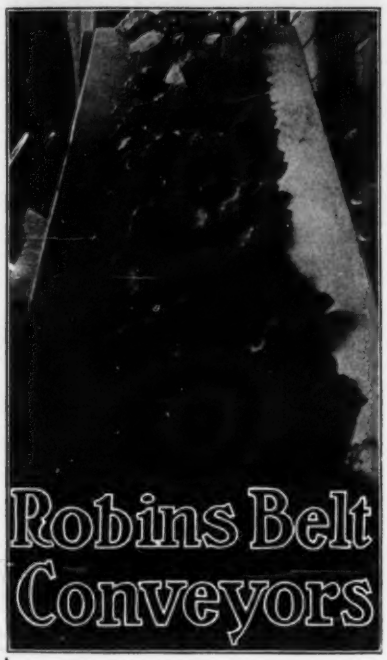

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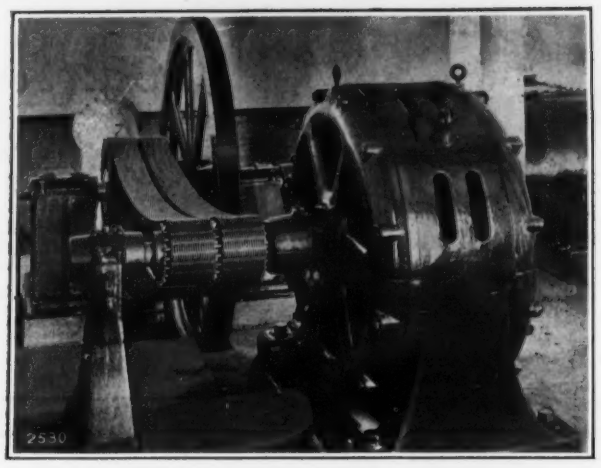

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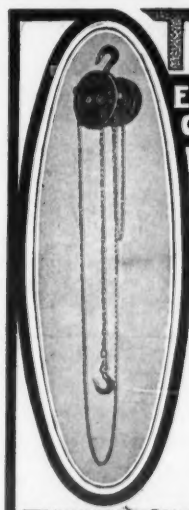

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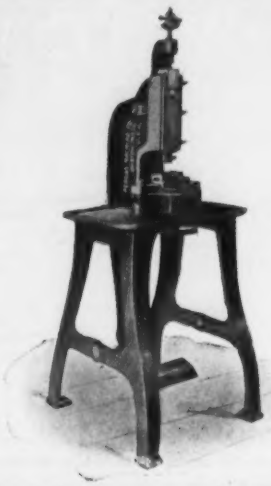

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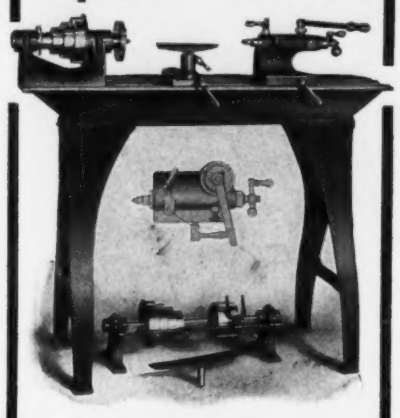

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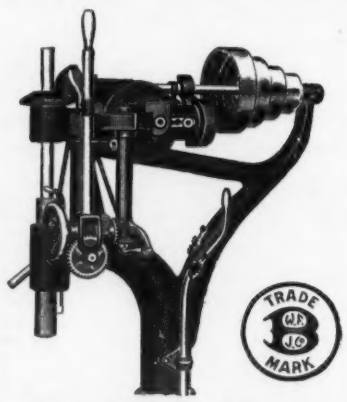

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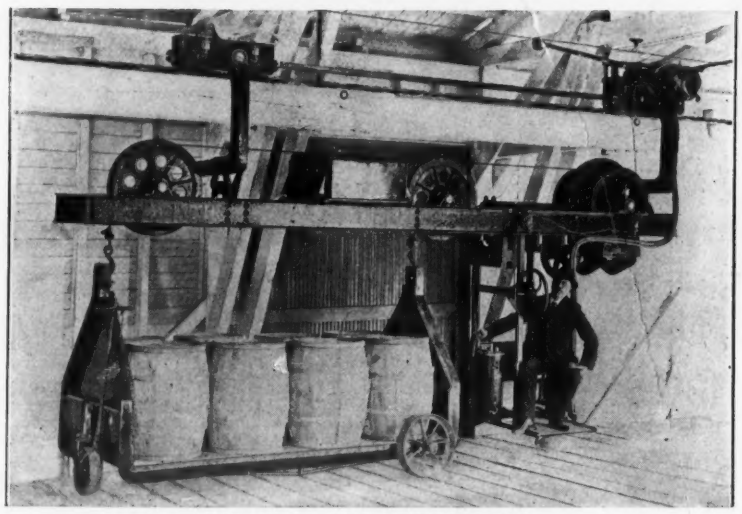

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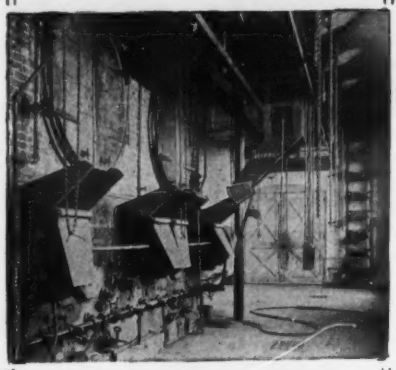

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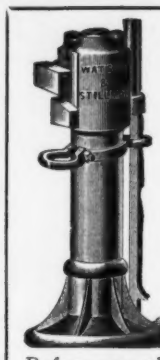

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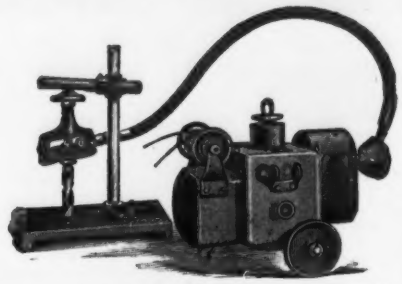

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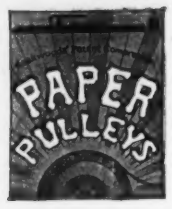

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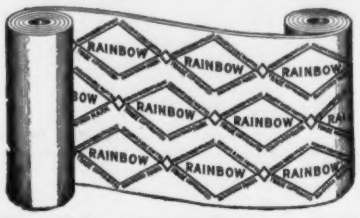

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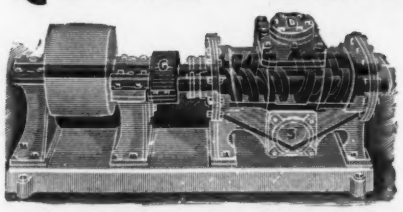

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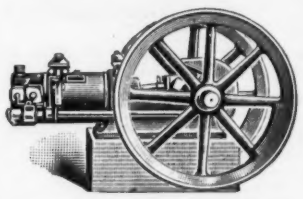

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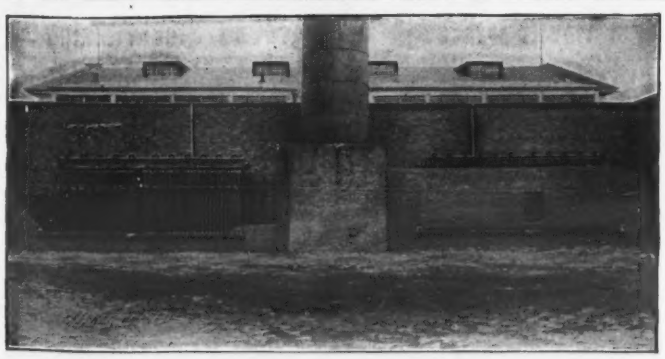

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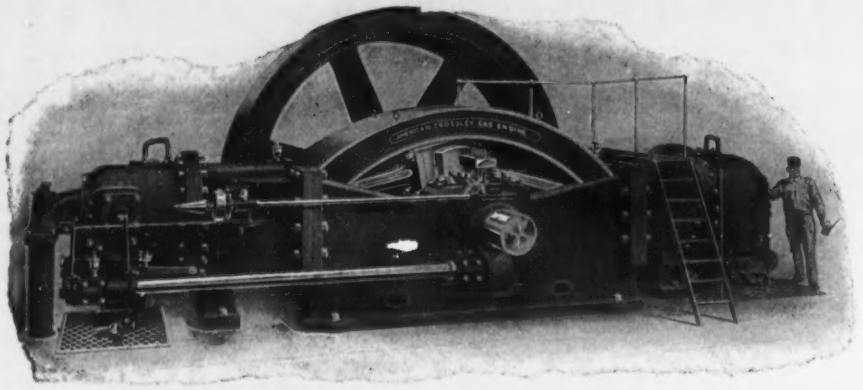

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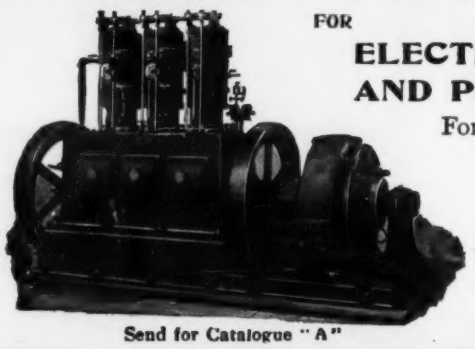

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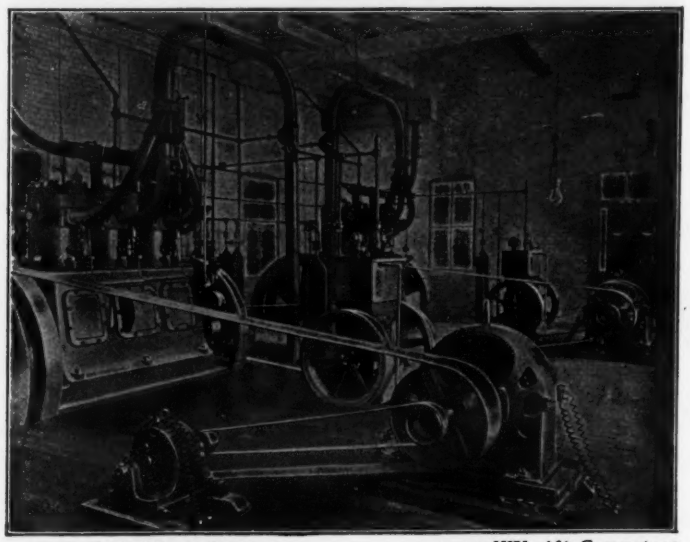

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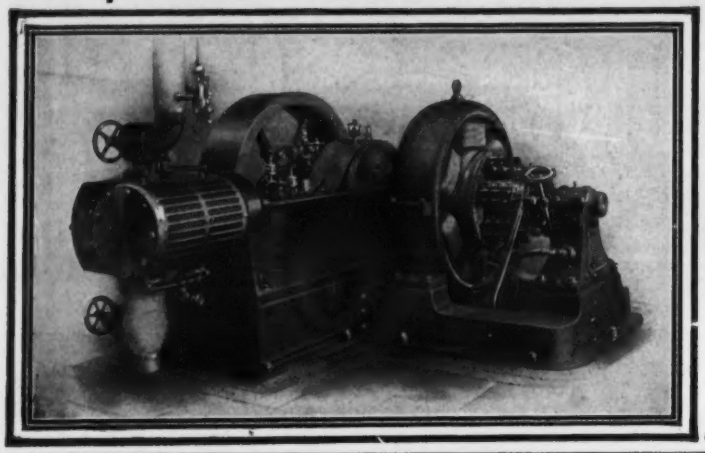

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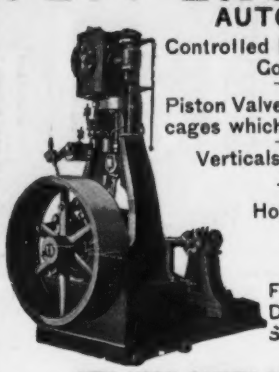

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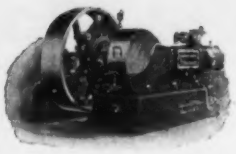

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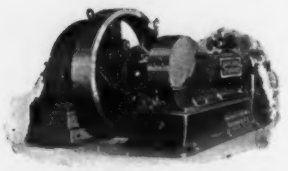

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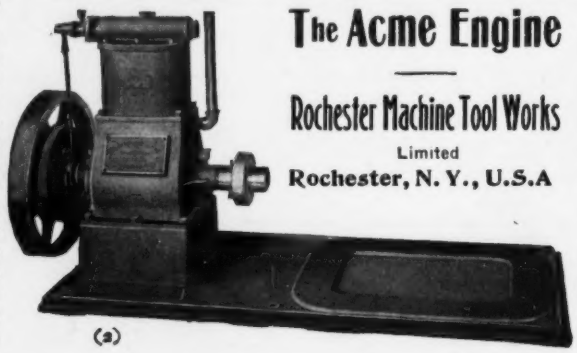

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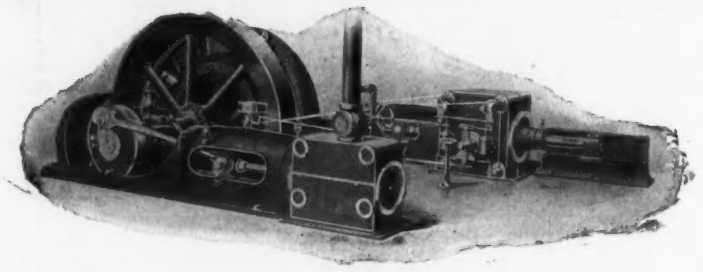

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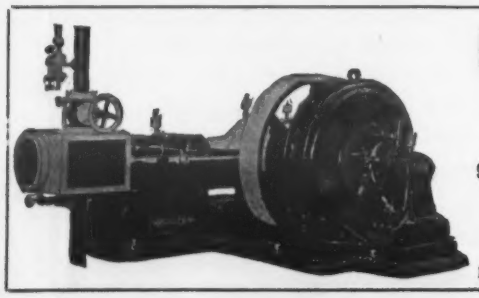

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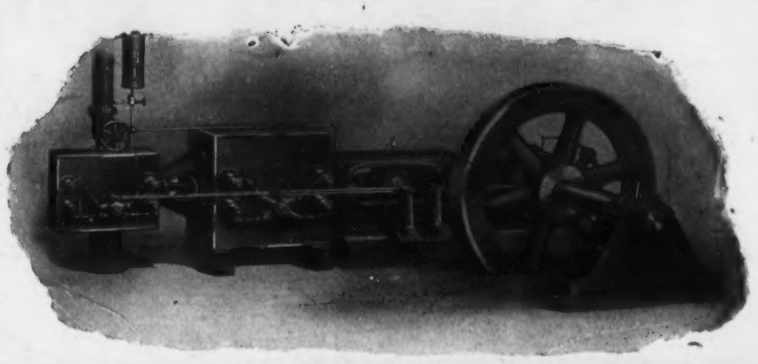

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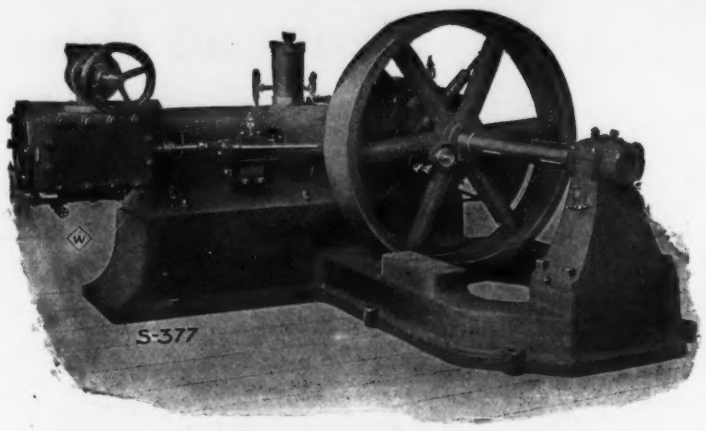

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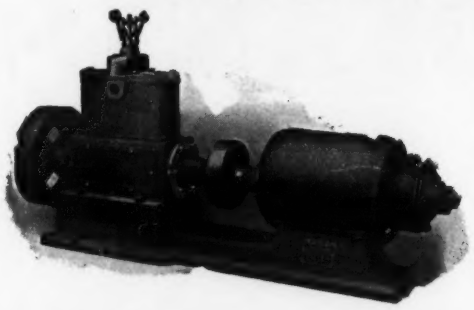

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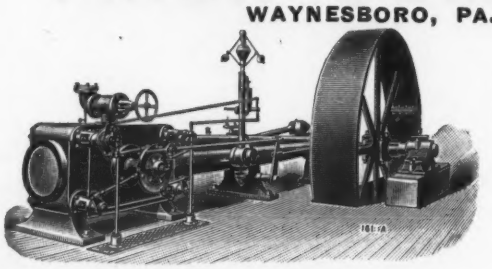

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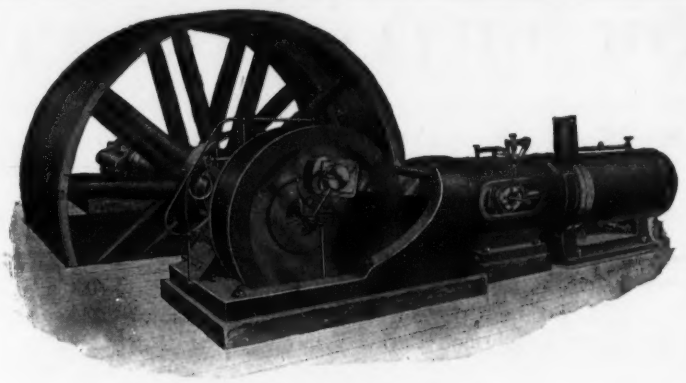

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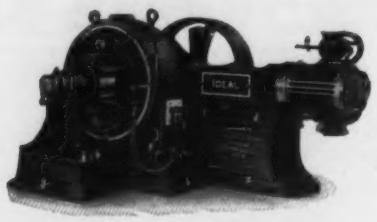

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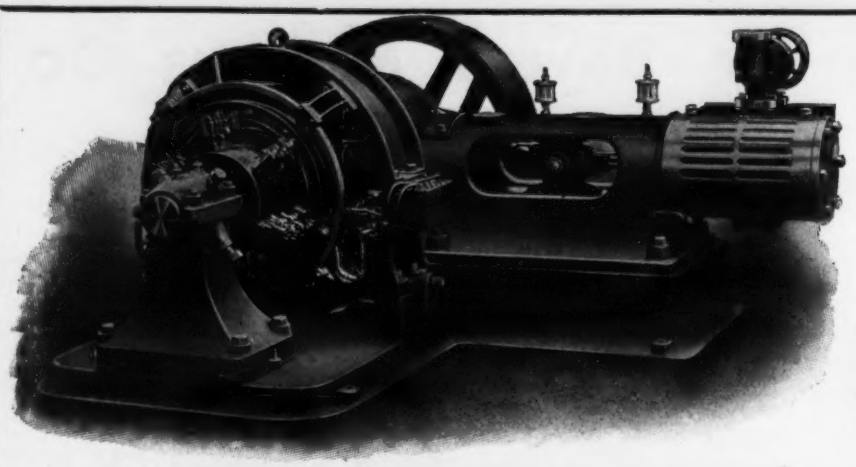

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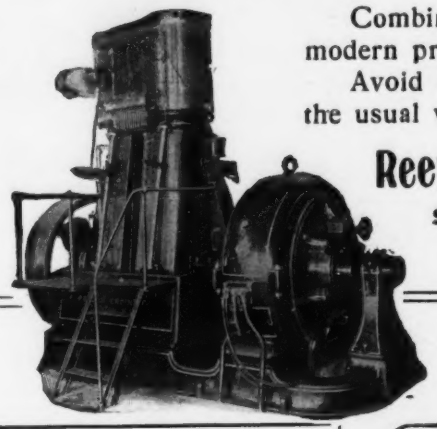

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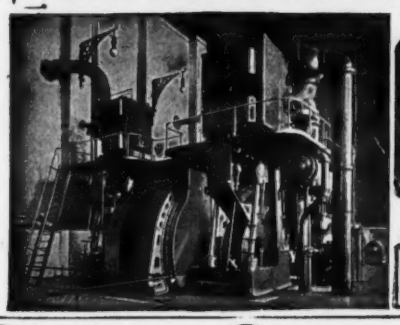

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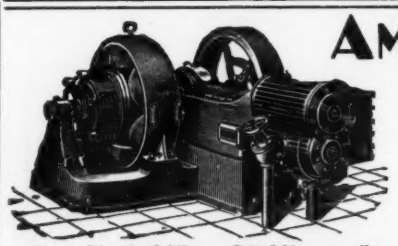

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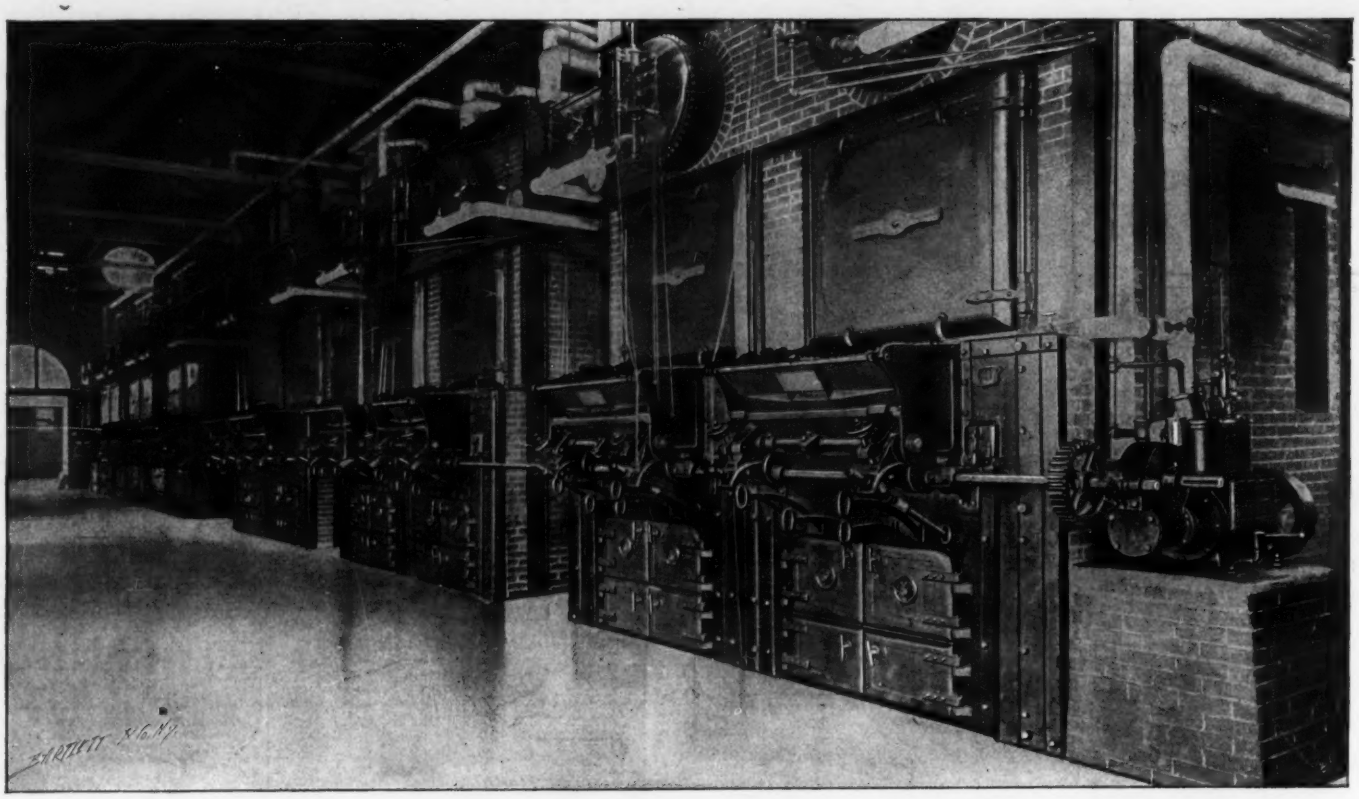

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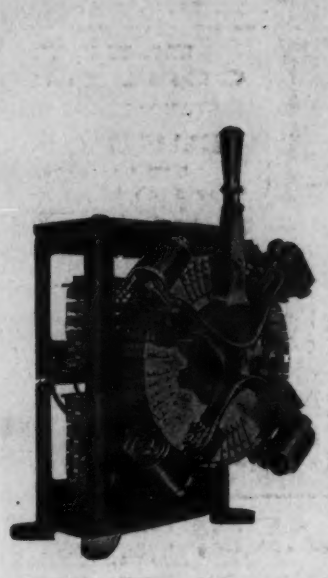

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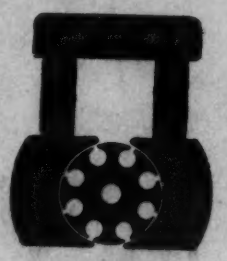

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